POWER PLANT ENGINEERING

Trade-mark reg. U. S. Pat. Office

VOL. XXIV CHICAGO, OCTOBER 1, 1920 No. 19

Power for a State Institution

AT THE POWER PLANT OF THE ELGIN STATE HOSPITAL LABOR IS AN UNIMPORTANT ITEM. NOVEL COAL STORAGE PIT UNDER CONSTRUCTION

FURNISHING LIGHT, heat and power to the 28 buildings comprising the Elgin State Hospital for the acute insane, the power plant herein described presents several interesting features not usually met with in power plant operation. This institution, situated on the Fox River at Elgin, in the heart of the famous dairy country of northern Illinois, covers an area of over 520 acres, and at the present time houses over 2100 patients. With its numerous buildings, its fire department, its bakeries and store rooms, it possesses all the aspects of a small city—with the one exception, perhaps, that its inhabitants are incapable of governing themselves.

The buildings are scattered over a considerable area of ground and since they are all heated by steam from the central power plant, it is obvious that unless the heating lines are well insulated, great heat losses are liable to occur in such an extensive system. The heating problem, however, has been successfully solved by the installation of a vacuum system of heating by exhaust steam which enables many of the rooms to be kept at a temperature of 90 deg. in winter when the outside temperature is 10 or 15 deg. below zero.

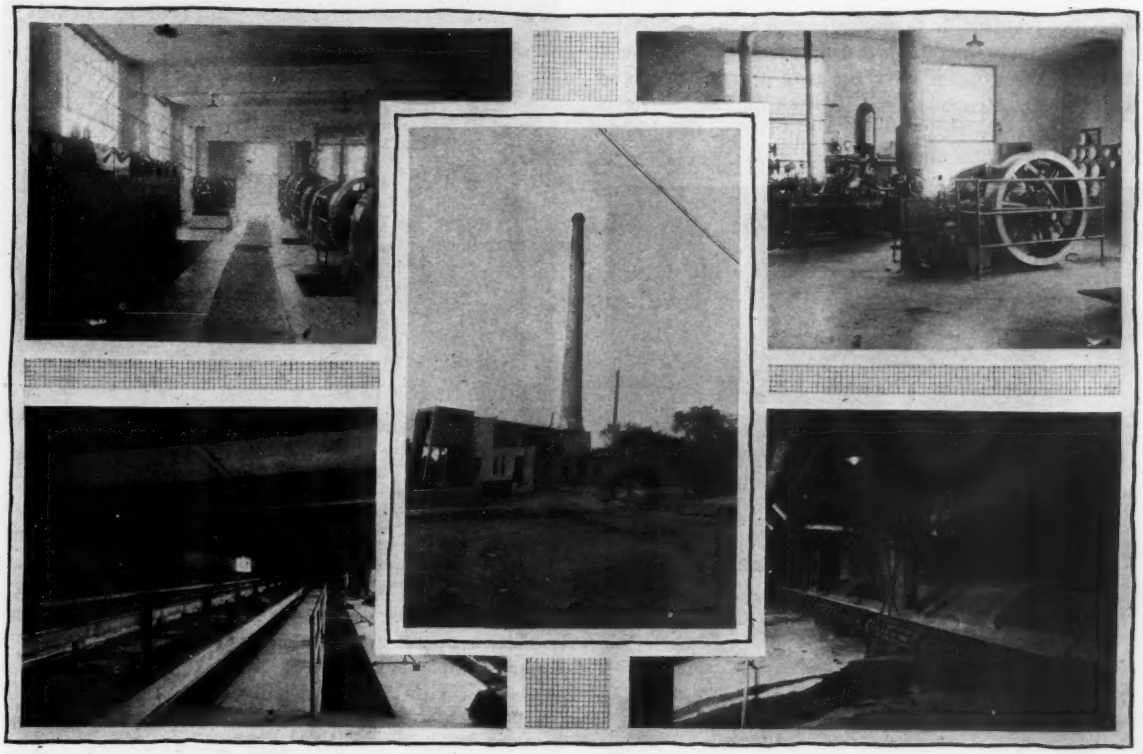


FIG. 1. VIEW OF ENGINE ROOM. FIG. 2. FIRE PUMP AND ONE OF THE GENERATING UNITS. FIG. 3. UPPER RUN OF COAL CONVEYOR ABOVE BOILER ROOM. FIG. 4. LOWER RUN OF COAL CONVEYOR SHOWING ASH PIT DISCHARGES. FIG. 5. EXTERIOR VIEW OF THE PLANT

BOILER ROOM

THE STEAM generating equipment consists of four horizontal water-tube boilers, two 300 hp., one 400 hp.,

and one 250 hp., all equipped with chain grate stokers. Steam is generated in the boilers at 100 lb. gage and is delivered to the engines at that pressure. The stokers are driven either from a 5-hp. vertical stoker engine or from a 5-hp., 110-v. electric motor. Under normal conditions the engine is used, the motor being installed for emergency use only.

Coal is delivered to the stokers from individual overhead coal bunkers by means of valve controlled spouts.

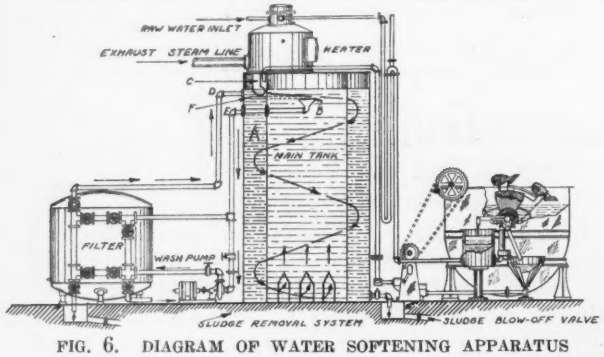


FIG. 6. DIAGRAM OF WATER SOFTENING APPARATUS

The supply of coal to each boiler is measured by four coal meters. The installation of these coal meters together with a number of other indicating or metering devices has resulted in a considerable saving—not because of the mere fact that these instruments had been installed, but because it gave the men a greater interest in their work. It created competition among the members of the various shifts—each shift trying to produce a better record than the other.

FIG. 7. CHEMICAL MIXER FOR WATER SOFTENER

No equipment for forced draft is installed, sufficient draft being maintained at all times by a 225-ft. Custodis radial brick chimney. The natural draft is controlled by an automatic damper regulator of the hydraulic type.

A 1250-hp. feed water heater of the closed type is located on the gallery at the left of the boilers. On this gallery is also located a domestic water heater used for supplying the various buildings with hot water, and a water softener tank in which the feed water is treated.

Under the heater gallery are located two 14 by 8 by 14-in. duplex feed water pumps, two 8 by 7 by 10-in. hot water pumps, one 16 by 10 by 10-in. circulating pump, and two 7½ by 8½ by 10-in. booster pumps. These are shown in Fig. 8.

The circulating pump is used only at night to circulate the water in the system in order to insure an even temperature.

Water Softening Apparatus

The water softening apparatus is shown diagrammatically in Fig. 6. The hot flow tank is divided into two chambers, A and B. Hot water from the heater enters through the turned inlet C above the baffle plate F, the softening chemicals being delivered to the incoming water through the pipe H. The turned inlet and baffle plate cause the incoming water to flow in a horizontal direction around and downward through the outer annular chamber A. This movement of the water automatically provides the agitation that brings the softening chemicals and water into contact. At the bottom of the softener tank, the water flows through the inverted V-shaped openings from the outer chamber A into the inner chamber or uptake B. Near the top of the uptake B the water passes out through the outlet pipe E.

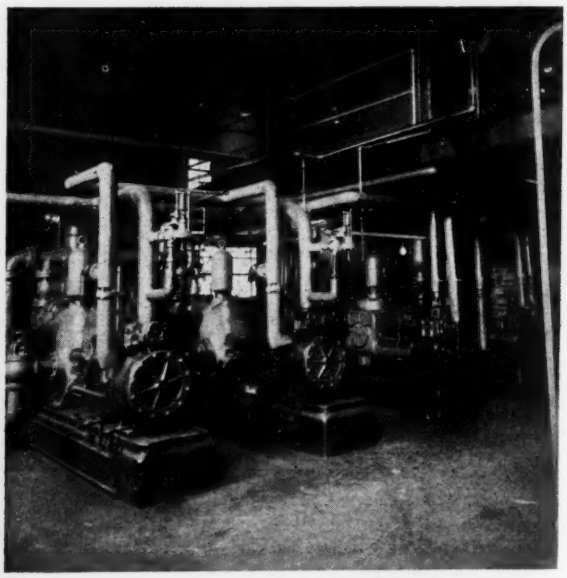


FIG. 8. FEED PUMP AND BOOSTER PUMP

The softening of the water is effected by treating it with hydrated lime and soda ash which are supplied from a chemical tank and feeder. The chemical tank and feeder in this installation is located in the basement underneath the fire-room where is also located the 6000 gal. per hr. water filter.

The flow of raw water which enters the apparatus through the head chamber is regulated automatically by a float valve in the supply pipe line. If the water is used more rapidly, the level in the main tank tends to fall, lowering the control float which opens the valve in

the supply pipe, letting more water enter the head chamber.

The head chamber through which the water flows to the heater divides the water into two proportionate streams. The larger main stream of water flows directly into the heater while the small one flows into the hydraulic link pipe. The two streams always flow in proportion to each other because the "head" of pressure of the incoming water governs the flow of both.

The hydraulic link conveys the small stream of water to the chemical float control independent of the back pressure in the heater and head chamber. As the rate of flow of water in the hydraulic link is always in proportion to the main flow of water into the heater, this small stream of water is used to control the chemical feed to the softener.

The installation of the above described water softening apparatus has practically eliminated all trouble due to scale. The water used for steaming purposes is spring water containing a high percentage of magnesium sulphate, and before the water was treated formed a very hard scale in the boilers.

Coal and Ash Handling Machinery

The railroad track runs close to the south end of the boiler room and the track hopper into which the coal is discharged from the railroad cars is located underneath the track as shown in the plan view, Fig. 10. An apron feeder runs from the track hopper to a crusher which is located directly over the buckets of the conveyor. The feeder transfers the coal from the track hopper to the crusher automatically and at a uniform rate. After passing through the crusher, the coal goes directly into the buckets of the conveyor which follows a rectangular path, below and above the boiler room.

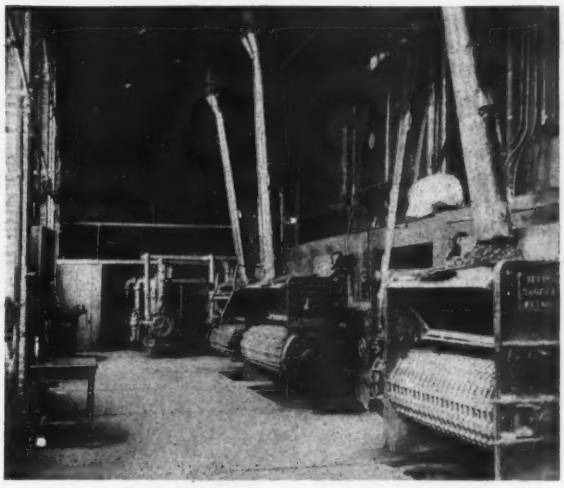


FIG. 9. VIEW IN BOILER ROOM

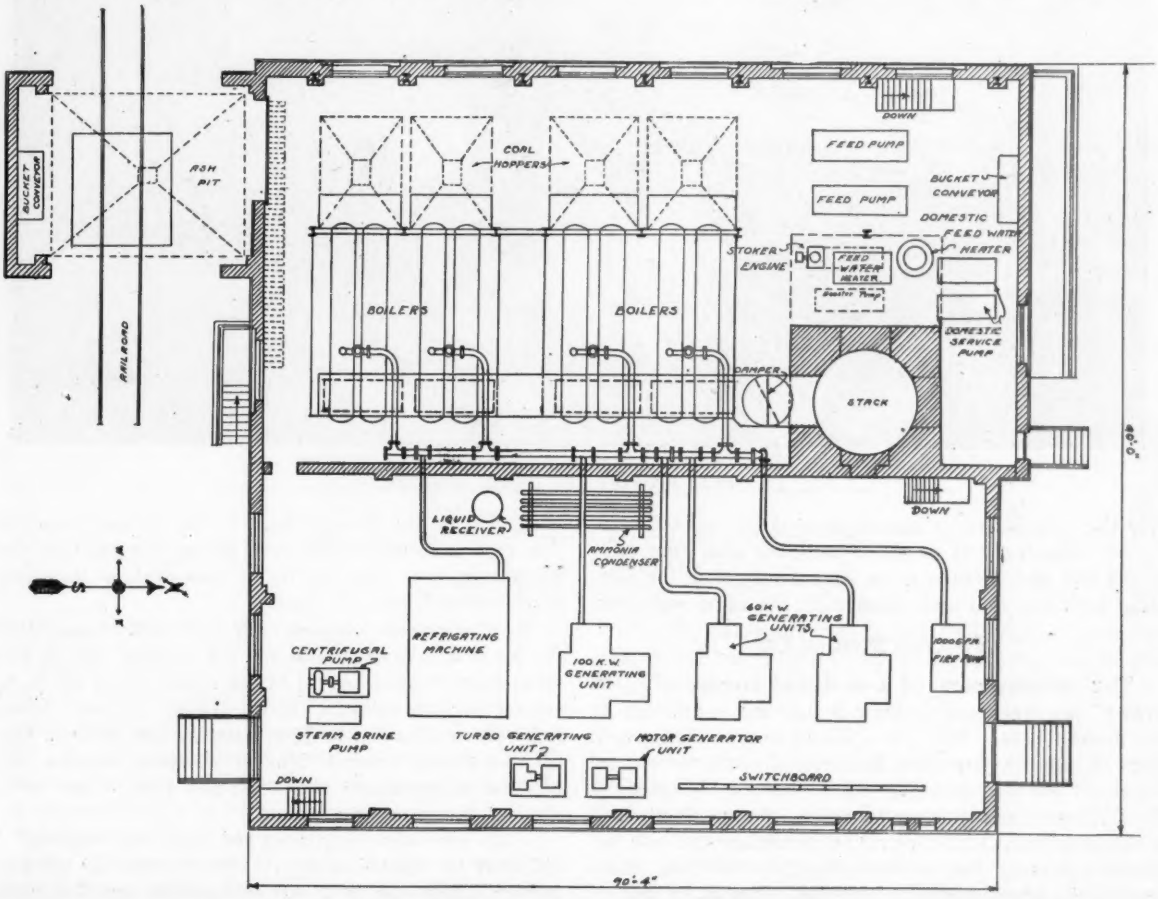


FIG. 10. PLAN OF ENGINE AND BOILER ROOM

In other words, the buckets go up the south wall of the boiler room, cross to the north wall, above the overhead coal bunkers in the boiler room, down the north wall, and return to the crusher along the basement floor in front of the ash hoppers of the boilers. The buckets thus make a complete circuit.

The coal is elevated and distributed to the overhead bunkers by the carrier buckets, the discharging of the buckets being accomplished by a movable tripper.

The ash pits are built the full width of the stokers and with sloping bottoms so as to form chutes leading to the lower run of the conveyor in the basement. The ashes having been dumped into the buckets is carried up and discharged into an overhead ashes bin, built out over the railroad track and supported by two columns.

The machinery is used for handling coal only part of the day and there is more than ample time for handling both the coal and ashes with the same conveyor.

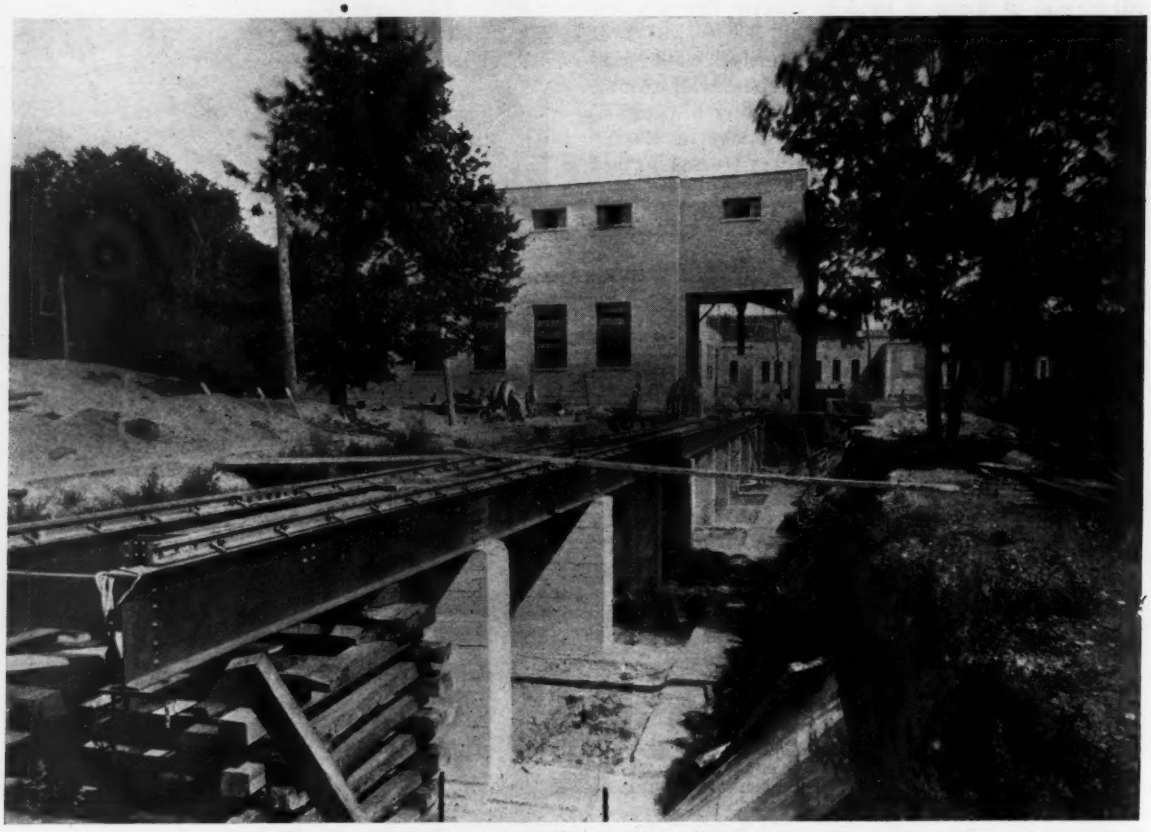


FIG. 11. COAL STORAGE PIT UNDER CONSTRUCTION

New Coal Storage Pit

THE CONSTRUCTION of a new coal storage pit just west of the track coal hopper is nearing completion at the present time. This pit is shown in the photograph, Fig. 11, and the essential features of construction are shown in the plans in Fig. 12. This pit, designed by F. J. Postel, supervising engineer of the plant, is a novel idea in coal storage pit construction and was designed primarily for an institution of this kind, where most of the labor is done by patients. It must be remembered that while this is an institution for the insane, not all the patients are violent or uncontrollable. Quite to the contrary, a great many are only affected in a light degree and under most conditions are capable of doing a considerable amount of work. And it is only humane to give them some sort of work to do for it affords an opportunity for diverting their minds. A certain amount of the work around the power plant, therefore, is done by the patients.

Heretofore, before the construction of the pit, coal was stored in large piles on the ground on each side of the railroad track. In winter, when transportation was tied up, it became necessary to use the coal stored in these piles, and as a consequence, the patients who handled the coal were exposed to the cold and were often compelled to dig the coal from under the snow and ice. This task was difficult and even though the patients were worked in very short shifts, it was evident that some improvement should be made.

So this storage pit was built. As will be seen from the plans and illustrations, the pit is about 160 ft. long with concrete piers placed in the center every 16 ft. for supporting the railroad track. Outside of each retaining wall and located midway between the concrete piers are constructed concrete bins with sloping bottoms, each fitted with a manhole at the top and a steel door in the side of the retaining wall.

Coal can thus be discharged from the railroad in either of the following ways: Directly into the pit from bottom dump cars, or it can be shoveled over the retaining wall and stored in piles above the manholes. In

the latter case, it can be stored above the ground until needed. Then, when a manhole is opened up the coal is discharged into the bin below and, when the steel door is opened up in the pit proper, the coal can be shoveled into push cars and wheeled into the boiler room basement. In winter, this will be under cover as the top of the pit will be boarded over, and the patients who do the work need not be exposed to inclement weather.

It will be seen that as far as labor is concerned, none is saved by the construction of the pit. In a state institution of this nature, however, labor is an unimportant item—there is always an abundance of it, and at no cost. The pit is designed then, not alone to afford coal storage but also to provide greater comfort for the workers.

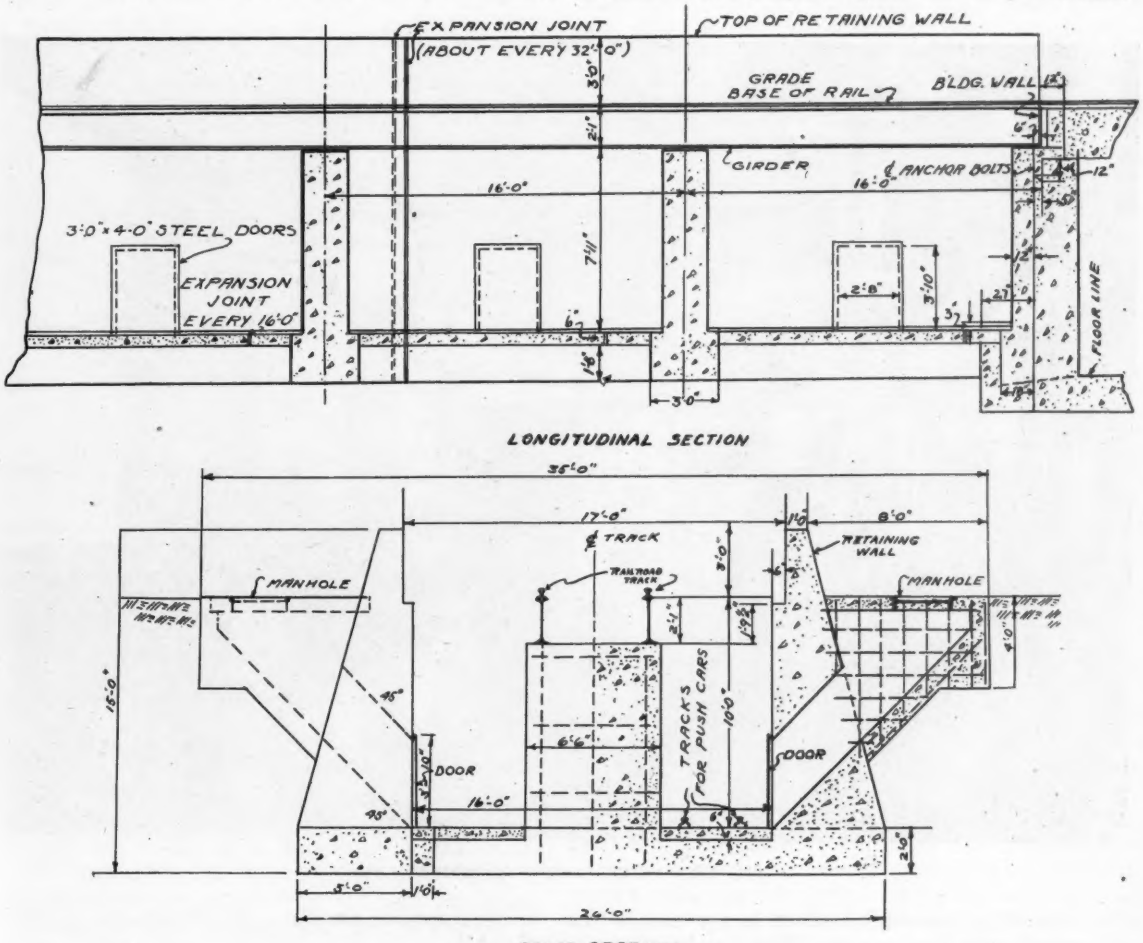


FIG. 12. SECTIONAL ELEVATIONS OF COAL STORAGE PIT

The Engine Room

The generating equipment consists of two 60-kw., 110-v., d.c. generators, each direct connected to a 13 by 12-in. engine and one 100-kw., 110-v., d.c. generator direct connected to a 16 by 16-in. engine. Direct current at a pressure of 110 v. is used for all power and light purposes throughout the institution except for pumping water from the river. For the latter operation 3-phase, 60-cycle alternating current at 480 v. is employed. This current is furnished by either of two 94-kv.a., 480-v., a.c. generators, one direct connected to a direct-current motor and the other to a 7200-r.p.m. steam turbine.

A vertical ice machine with 10 by 15-in. ammonia cylinders and driven by an 18 by 15-in. Corliss engine occupies one end of the engine room. A 2-in. motor-driven centrifugal brine pump is also located here and is used to circulate the brine through the coils in the kitchens located nearby, as well as the ice tanks. This centrifugal brine pump is supplemented by a steam-driven, direct-acting brine pump for emergency use.

At the opposite end of the engine room from the refrigerating machinery is an 18 by 10 by 12-in. fire pump capable of pumping 1000 gal. of water per minute.

In the basement underneath the engine room are located the two 12 by 14 by 20-in. vacuum pumps used in connection with the vacuum heating system.

Pumping Station

On the river bank a half mile from the power plant is located the pumping station. Here water is taken from the river and pumped to a standpipe on a hill near the power house, from which it is drawn for sewage purposes and for watering the extensive vegetable gardens.

The pumping equipment consists of the following: One 2½-in. centrifugal pump, direct connected to a

35-hp., 440-v., a.c. motor; one 5 by 6-in. triplex pump geared to a 7½-hp. motor, and one 8½ by 8-in. triplex pump belted to a 50-hp. motor. As stated above, the current for these motors is supplied by either the motor generator set or the turbo-alternator located in the engine room.

Operation

As stated before in connection with coal meters, a considerable saving has been effected since the installation of suitable recording instruments and meters. The amount of coal consumed during the year ending June, 1920, is almost 2000 tons less than that consumed during the preceding year under the same load conditions,

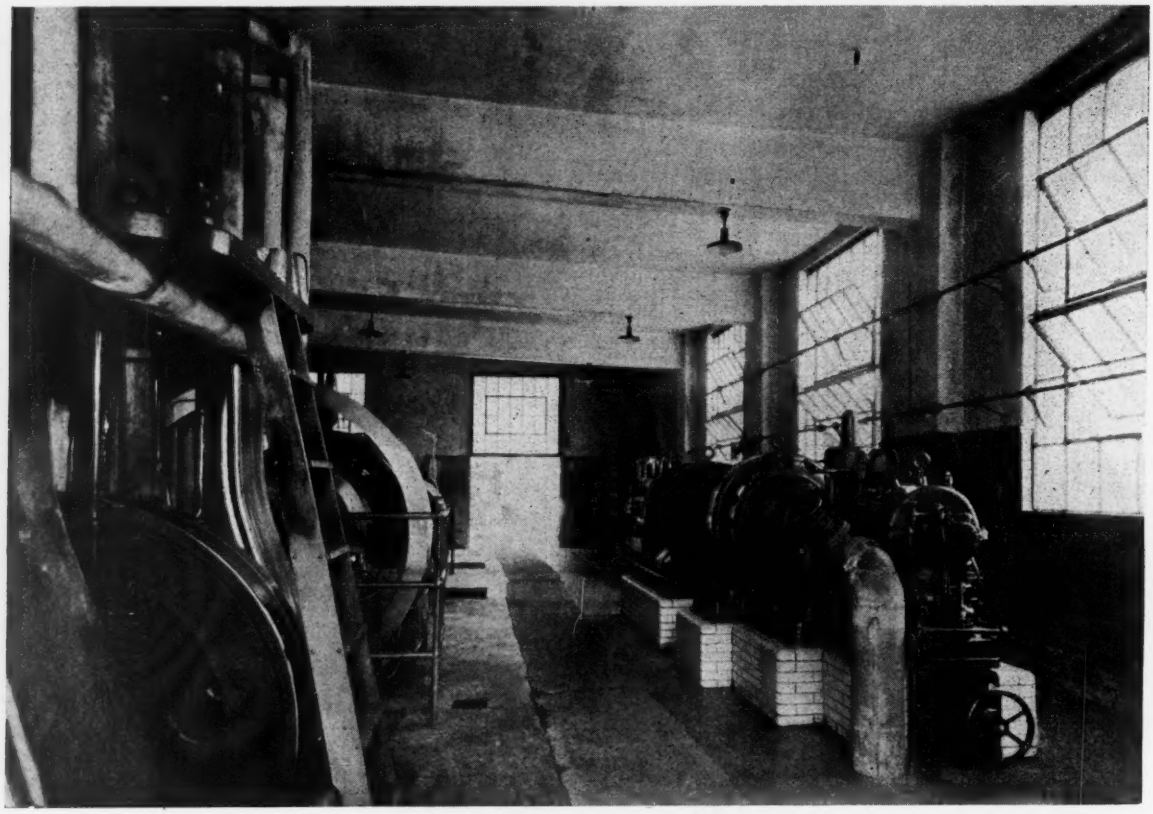


FIG. 13. GENERAL VIEW OF ENGINE ROOM

which represents a saving of about 16 per cent of the total annual coal consumption. This has been accomplished not by any one particular thing, but more by a systematic stopping of leaks and the prevention of careless waste of power.

Credit is hereby extended to M. S. Maston, chief engineer of the plant, through whose assistance and cooperation the preparation of this article has been made possible.

According to government reports the proposed extension of hydro-electric projects in Japan will involve the building of about 1000 mi. of high tension transmission lines within the next 2 yr., steel towers will be used extensively.

Coal and Our Coal Supply

By J. B. Dillon

While many may not agree with Joseph W. Hays, president of Hays School of Combustion, of Chicago, still he has sounded a warning that will pay all to heed and obey. In a recent address he said: "The coming winter, in my estimation, will bring the greatest fuel shortage this country has ever gone through; however, the production of Colorado's coal alone, if efficiently developed, will prevent any great suffering in the West. As a reasonable estimate, 25 per cent of the coal is needlessly wasted, and the total waste that might be prevented from the time the coal is mined until it gets to the consumer amounted to 50 per cent of the coal mined."

Prof. Hays fears that our supposed unlimited coal deposits will be depleted within a few years in the same way that our natural gas, timber and petroleum are threatened with exhaustion.

Only 16 per cent of our coal supply is accessible to mining. Of this 16 per cent that can be mined, 3 per cent has been mined within the past 75 yr. and the coal consumption is increasing at a rate that will exhaust the supply within a few years if it continues.

Figures exhibited proved that the per capita consumption has increased from 304 lb. a year in 1860 to 13,172 lb. a year in 1919.

Many illustrations showed the saving way of handling coal, the speaker making everything clear.

The Future Status of Power

INCREASE OF PRODUCTION REQUIRES ORGANIZED CONSCIENTIOUS AID OF ENGINEERS. BY L. W. ALWYN-SCHMIDT

WHATEVER statesmen, producers and scientists may think individually about the present day industrial situation, they all unite upon one fact, that it will be necessary to increase production before a radical change can be brought about. The processes of manufacturing must be accelerated so that the industrial machine throws out more of the ready product. To accomplish this two factors will need attending to: the supply of raw materials and the supply of industrial energy, commonly called power.

Much as the industrial raw material stands to the industrial product, so stands power supply to all industrial effort. It is, in a manner of speaking, the raw material of all industrial energy. You cannot make a good product with an inferior raw material; neither can you expect smooth industrial operation without the supply of high-class power. The engineers in control of the national power production, be it in individual plants or in central stations, hold the key, therefore, to all efficiency in industrial production. With the power engineer starts the body of the industrial army, which broadens rapidly out until the outer trenches are reached, which holds the workers in the factories, the men who turn the raw material into the product.

To hold in order the equipment for producing industrial power and to co-ordinate its output perfectly with the demand for its particular product, has become a science in itself. It is an economic process which, while carried on still individually by hundred thousands of men, requires an extraordinary skill of co-ordination of effort because of the comparatively small number of power sources that are at the disposal of the power engineer at the present time.

SOURCE OF POWER LIMITED

FOR ALL practical purposes, we know today only three fundamental sources of power. These are, in order of their importance: coal, water, oil.

Coal, which has proved the most effective source of power, also has developed in the course of time to the most wasteful, owing to the enormous destruction of secondary values that are lost to the national household by the system of burning coal for the purpose of power generation. It is, of course, not the fault of the modern power engineer that this should be the case, because he had to deal with conditions as he found them. By a peculiar twist of our technical and economic development, steam was discovered before the powers of electricity were known. The reverse might easily have happened and one wonders sometimes, how our world would have developed in this case. Would there be no steam engines at all today? Would coal be left in the bowels of the earth and would water power and wind energy take its place as a producer of power, heat and light? As it is, steam came first and the reasons are easily explained. Most of the industrial power of any country is still produced with steam and considering the enormous investment which has gone into steam power equipment there is no chance of its being driven from its present position for many centuries to come.

Of course, if steam power generation would be wasteful exclusively, if there were nothing to recommend it except the fact that it came first, it would hardly withstand the progress of technical development; but the fact is that, notwithstanding its many disadvantages, it also has advantages which make its retention desirable under present day industrial conditions. To make, therefore, any attempt to improve the co-ordination of power production by doing away with the steam generation in factories entirely seems to be as hopeless a plan as doing without armies during the next 100 yr. We have to accept conditions as we find them because we cannot well change them in the lifetime of a generation, and rather build up on them in order to accomplish improvements. The difficulty in the way of such a course is that we have to deal not only with the stubbornness of the object, but still more with that of the person. The steam section of the power industry draws its men from all sources and there is naturally a vast difference between the semi-skilled boiler tender and the highly trained power engineer, having a command not only of the problems of his immediate surrounding, but the vision of that vast organization of productive energy concentrated in the steam power industry.

How much co-ordination can be brought into this somewhat incongruent mass of human endeavor has been shown already during the war. Then the problems involved, however, were comparatively simple and easily explained. Coal was to be saved in the individual power plant by cutting down the consumption and by increasing the effectiveness of the power equipment. This is a plan that can easily be explained and those in charge of its realization had the additional advantage of finding an audience worked up to a pitch of national co-operation. Now the enthusiasm of the war has gone but the problem of power co-ordination has rather increased, because of the added problem of having to increase national production. Co-operation in the sense of the word during the war is less noticeable and individual effort must replace it. But it is essential that this effort should lead to one desirable point. There is no sense in letting the power industry drift with some men forging ahead while others saunter along the road, and still others press in the opposite direction. If progress must be, and there is no human being that can effectively prevent it, it may as well lead all in one direction.

The principal aim is clear. It is the increase of industrial production without the corresponding increase in the employment of human and machine power. Can the steam power men unite on some program of action?

STEAM POWER INDUSTRY BACKBONE OF POWER SUPPLY

THE WRITER does not hold a brief for any special form of power production, but he cannot deny the fact

that whatever is done during the coming years with respect to co-ordination of national power production must be done first by the steam power industry, because it is not only the leading power producer but practically the only one in many districts. The principal economic objection against all individual power production as represented today in steam power generation is the splitting up in effort that occurs in the supply and handling of the fuel. This is a complicated matter to deal with, but there is no shirking the fact that it will have to be faced once and that some heroic measures will have to be taken, if individual steam power generation is to be retained as a factor in industrial power production. The frequent strikes of truckmen, the strikes in the mines and the necessity of holding a comparatively large personnel in the power houses for firing make direct coal firing cumbersome and uneconomical in the highest degree. In time, it will not only be cumbersome, but it may become so expensive as practically to exclude its economic feasibility. This argument against the direct use of coal for firing individual power plants is now strengthened by the discovery of the by-products of coal and the fact that our coal supplies are the source of many products which we require for the conduct of many of our industries. We can no longer afford to permit individual power producers to fire this coal under their boilers in the manner in which it is done today and to waste millions of dollars of valuable raw materials contained in that same coal while doing so. The large coal consumer might easily correct this state of affairs himself by having his own small byproduct plant which preserves the byproduct while giving to the boilers the heat value of the coal; but this is absolutely impossible for the medium sized steam plant, not to speak of the great number of smaller ones. Considering that today 15,000,000 tons of coal are used approximately for industrial purposes alone, excluding the use that is made of coal for gas and taking in account the high cost of gas and the large prices paid for the byproducts of gas, the financial waste is appalling.

The question, therefore, arises how far coal might be carbonated centrally and its heating value transferred to the power plants of the industry by way of a gas piping system.

The benefits of such a change seem to be considerable on the face of it, but it is naturally up to the power engineers themselves to say whether they prefer such a change. It is the only change that can be suggested which will bring a real improvement outside scrapping the whole present steam power equipment.

Increasing Economic Efficiency by Saving of Coal Values

The domination of steam power generation is made more pronounced still by the fact that steam power generation is resorted to in many instances for the production of electrical energy. Here is an instance where the steam power plant makes competition for itself by supporting the generation of a form of power which is steadily encroaching upon the field of steam power generation. There are still few instances where electrical power has actually put out of operation steam power plants of considerable size; but how many more steam power plants would exist today if electrical power had not become a factor in industrial production? There is, however, one consolation to the steam power engineer. If the electrical industry can not do without steam power generation in more than 50 per cent of all electrical central stations, then the same economic disadvantages which apply to individual steam generation also apply to steam generated electricity. There is the same waste of coal values and of human energy. Hence, if it should become inadvisable to apply gas firing to individual power plants in factories, it should be still more the case with the boiler systems of the large electrical central stations. Electricity, although a competitor to steam power generation in the field of direct application, is also dependent upon steam power for its own source of power, unless it is able to draw its original power source from some other medium as is the case with the hydroelectric power station.

The invention of the steam engine threw water power out of its job a century or so ago. It is now coming back with a vengeance by way of the electrical central station operated by water power. Water power in this respect is a direct competitor of steam power; but it can hardly be regarded as a competitor of the power industry as such, because it is an integral part of it. Just let us get clear upon one great truth in all power coordination. Wherever coal is lacking natural power sources are in the ascent. At the present time, only water power is resorted to in an organized manner; but there is no saying whether wind power will not be used as extensively in the future. There is one objection, however, against the exclusive use of either. Water and wind do not give any byproducts. The burning of coal, while wasteful under modern industrial conditions, becomes a source of wealth when organized in a proper manner by the aid of machinery for the purpose of extracting the byproducts. Where coal and water are found side by side, the condition may actually occur that it is more expensive to use water, because of the profits that may be derived from the manufacture of coal byproducts.

Power engineers who take an interest in the economic development of their industry will do well to keep these facts in mind. It will help to understand better the interconnecting economic actions that will affect power generation during the next years.

To obtain a perfect balance of our industrial forces, therefore, it will be necessary to organize not only the consumption of coal for the purpose of saving its byproducts, but to encourage also its use in order to bring about the most favorable conditions for the production of these byproducts. It means that the generation of electricity by water power or any other form of transmittable power should not be resorted to in excess of the fair share that must fall to it in a well ordered national household.

Oil Sources Limited

Oil takes a peculiar place in the economic composition of the world's power industry. It appears both as a fuel for the steam power industry and as one for the internal combustion engine. It is an aid to steam power production and a competitor at the same time. It is not always a pleasant task to have to kick down a popular idol, but the impression is gaining ground, that oil

just now is a little "overdone" and that the present enthusiasm for oil will cool down somewhat after it has been placed in its proper corner of the national power household.

There is little that oil can give as an industrial fuel which is not duplicated by one or the other of the leading industrial fuels of the present time. Its only recommendation is that it can be employed in regions where coal is difficult to be obtained, where gas cannot be connected and where there are obstacles in the erection of an electrical central station. The farm, the small mine and similar enterprises can make excellent use of oil. Shipping has employed oil with advantage. Whether it ever will be used upon a large scale as an industrial fuel in connection with steam generation is questionable. Its usefulness for this purpose it exceeded by that of other heating systems as for instance gas, while its use as a direct power generator for small industrial enterprises is far outdistanced by the much more convenient electrical motor.

But the principal economic objection against the use of oil as a fuel, except in those circumstances where its employment is of special value, as in shipping, etc., is the comparative limited stocks of mineral oil that are available. It would be a great mistake to reorganize our industry upon a system of oil burning, to find later that the supplies of oil are not sufficient to answer the demand.

Power Development Must Proceed According to a National Program

The next years will be years of great technical and economic changes. The readjustment of values has only begun, and 10 yr. and more will pass before the process started with the war is completed. During this period, we shall undergo a new industrial revolution. Machine power will be used in ever larger amount and with the employment of machinery will come an enormous increase in the demand for power. The power engineers will have to supply that power in one way or another. They may do this either in the haphazard manner in which the power business of the world was conducted during the last decade or they may strike out for a policy of their own, destined to make power generation the result of a highly specialized national organization which not only supplies power but takes care also of the many supplementary factors involved in power production and distribution.

It is necessary that power production and distribution should be developed in a direction which will lead to further possibilities, avoiding the danger of bringing it suddenly to a stop. There would, for instance, be no advantage in permitting the growth of the power production by oil unless complete security can be given at the same time that there will always be a sufficient supply of oil to take care of the demands of the hundred thousands of oil motors that are already in use and most likely will be constructed during the next 20 yr. This does not mean, of course, that the use of oil as a fuel should be stopped, but it means that oil motors should be employed only where their employment promises special advantages. There is also little economic justification for the employment of large steam driven electrical plants in sections of the country where water can fulfil that service much better. Little can be gained by cutting down deliberately coal consumption, because of the loss to the chemical and other industries caused by such an act. But it is desirable that coal should be employed in the most economical manner. Byproducts should be saved and the economic loss caused by transporting the coal to individual consumers should be eliminated.

To accomplish all this, co-operative action is required. The power industry will need a technical program. This program should be agreed upon after a thorough consultation of power engineers and should form the basis for further development work and general research. The aim must be greater efficiency for the purpose of better service.

Forced vs. Induced Draft

By W. F. Schaphorst

MANY engineers are not conversant with the advantages of forced draft over induced draft. It is generally thought that one is "about as good as the other," but that is not the case. The writer has delved into the subject to no little extent and is inclined to place himself on the side of forced draft.

An ordinary chimney "works" because the column of hot gases inside the chimney is lighter than a similar column outside of the chimney. An unbalanced force is therefore set up and, in an attempt to balance things in a natural way, the outside air rushes into the base of the chimney, forcing the hot gases upward and out. But some engineer conceived the idea of making the rushing air pass through a fuel bed to support combustion, and thus the supplanting air itself becomes hot and is pushed up by more cool outside fresh air. So the operation continues automatically as long as there is a higher temperature in the fuel bed than in the outside air. Chimney draft is induced draft. A so-called "partial vacuum" exists in the chimney, over the fire, and under the fire in the ash pit.

Induced Draft

Induced draft imitates the chimney method by creating a partial vacuum over the fire and under the fire. It is a "suction method." Its best feature lies in the fact that it does not force flame or gases out of the boiler at any point. But even that "favorable feature" is chalked up as an argument against it, because if the boiler setting is leaky, surplus air will be drawn into the gases which will necessarily be heated. The heat absorbed by this surplus gas will therefore have to go up the chimney as pure waste. Besides, with induced draft, there is no way to determine in a simple way whether or not the fire is getting too much air.

Again, the fan handling these hot gases will have to be large enough to take care of the increase in volume due to the increased temperature of the gases. When

outside air is increased in temperature by 500 deg. F., it doubles in volume. Hence the fan has a "harder and bigger job" handling the air after it is heated than before.

Forced Draft

Already, no doubt, the reader who has never before given this matter thought sees the advantage of forced draft. The forced draft turbo or other blower is so placed as to create air pressure in the ash pit beneath the grates. Nothing but cool outside air is handled by this blower. It is best to regulate this pressure in such a way that there will be no pressure on top of the fuel bed; for if there is greater pressure than atmospheric on the fuel bed, flames will shoot out of the firing doors every time the fireman opens them to feed the furnace. Hence the desirability of using a chimney in conjunction with a forced draft blower. The chimney need be only high enough and large enough in diameter to create a trifling suction over the fuel bed. The greatest pressure difference to be overcome is through the fuel bed, and that pressure difference or "draft" is cared for by the blower.

As stated above, less power is required to drive the forced draft fan in handling a given weight of air or gas; but the forced draft system has the further advantage in that its turbine and fan are always in a current of cool air. Consequently they will naturally be longer lived. This applies particularly to the bearings, for it is much easier to keep cool bearings in economical running condition than to bother constantly with bearings in hot surroundings which must be water cooled in order to keep them running at all. Thus the lubrication problems attending the induced draft system are more complex than those attached to forced draft.

All in all, this is a rather complex problem to handle in a single paragraph or even in a single article. It cannot be stated definitely whether or not a given chimney should be removed and supplanted by forced draft or whether the forced draft fan should be used in conjunction with the chimney. Nevertheless, if additional power is contemplated, it is unlikely that the chimney will ever have to be enlarged, provided a chimney already exists. The forced draft turbo blower will usually take care of the matter nicely.

In certain instances, it has been the policy for engineers to keep two or three boilers going with one in reserve. The latter reserve boiler would have its fires banked and the water in the boiler would be kept hot by use of live steam, so that as soon as a peak load came along, it would be a simple and quick matter to cut the extra boiler into the main steam line. Naturally, such practice is wasteful because of the extra coal required to bank the fires, because of the live steam required to keep the water hot, and, what is more, because of the extra boiler, which would have been unnecessary had the other boilers been equipped with turbo blowers.

Steel, at the present time at least, is a scarce article. One excellent way to save steel is to require fewer boilers. Or, if it is thought that another boiler might be necessary in the plant, it is quite possible that a turbo blower will do just as well. In fact, a turbo blower will very likely be a "better" proposition than a new boiler.

How can a turbo blower take the place of a boiler? By increasing the capacity of present boilers. Boiler ratings, in modern times, don't mean much. A boiler may be rated at 100 hp. and in one plant the purchaser may religiously abstain from forcing the boiler higher. Yet, in another plant, the owner or engineer may see an economy in forcing the boiler to 300 hp. Such things are done every day without evidence of harm to the boilers. In fact, it usually seems to pay to force boilers considerably above capacity.

Then comes the additional advantage of forced draft; by its use you can burn almost any kind of fuel. As one manufacturer expresses it, "you can burn dirt." And now, since so much of the coal handed out to us is practically "dirt" it is almost a necessity that forced draft be adopted. Besides, there is no good reason why a high price should be paid for large lump coal simply because the lumps are so large that air can get through easily via chimney draft when that coal lies on the grate bars. Usually there is but little difference in the heat value of large lump coal and fine coal per ton. So, if the fine coal can be purchased at a much lower price, why not buy it, buy a blower, save money, and get along better than the owner or engineer who insists on buying the "best" coal. Too many coal buyers are possessed of the idea that the "best" coal has the highest price attached to it, but that is far from the truth. The best coal is the coal that will turn out the work at the least cost. Just what the least cost is may not be an easy thing to compute, because so many different factors are involved. Suffice it to say, though, that cheap coal has many times been proved to be the best.

The best way to install turbo blowers is to allow one for each boiler. Do not attempt to put in a single blower and distribute air from it through ducts to each boiler. It can be done, true enough, but blowers do not cost much, and matters are much simplified by installing one blower under each boiler. Then, when that boiler is shut down, the blower is shut down with it. Also, when operating, the speed of each blower can be regulated to provide sufficient air for immediate necessities. A single large blower for a number of boilers requires constant adjustment and vigilance.

Electric Lamp for Miners

By J. B. Dillon

We have often heard the adage, "Never give up an old friend for a new."

Evidently the miners of the Rockvale, Colo., mines had this moral engraven on their minds when 600 of them quit work because James Dalrymple, state coal mine inspector, forced the concern to adopt the electric lamp for miners, in lieu of the old gas lamp, the state law making the substitution mandatory.

The miners contended that the light from the electric was not of sufficient intensity; the danger of the gaslight seeming trival to them; but after a prolonged explanation and demonstration of the real value of the electric lamp, the "boys" decided the electric lamp was superior, safer and more serviceable generally, and then they returned to work.

CHARLES J. WILDER

HE WORKED 14 HR. A DAY AND RECEIVED $9 A WEEK ON ONE OF HIS FIRST JOBS. NOW CHIEF OF A LARGE NEW ENGLAND MILL. BY WALTER PAINTER

JOSHUA O'LEARY claims that the rigorous climate has something to do with the fact that Massachusetts has developed more capable power plant engineers to the square inch than any other territory. Anyhow, the day is not far distant when the Bay State will be as famous for its engine room craftsmen as for its bootmakers, bean-eaters, and statistical experts.

C. J. Wilder

Early starters, too, were most of the present class. Take the case of Charles Wilder. He will not admit that he was able to read an indicator card before he could walk on stilts or swim dog-fashion, but he does confess neglecting some of his high school work in order to serve as an engine room apprentice in the plant of the Bacon & Sibley Co. at Spencer, Mass. Think of a 15-yr. old youngster working around an engine room today!

Just after he was graduated from high school, Massachusetts passed the law requiring licenses for engineers and firemen, and Wilder, at eighteen, passed the tests for a Third Class Engineers' license. At nineteen, he qualified for the Second Class certificate and at twenty-four, held the coveted First Class license.

Mr. Wilder's first job consisted in looking after two small engines. At the mature age of nineteen, he was in charge of the Bacon & Sibley plant, which was then equipped with a 66-in. return tubular boiler and a 14 by 36-in. Green engine. No watchman was employed and it was not uncommon to put in 14 or 15 hr. a day. Nine dollars a week standing pay was the salary attached to this job and when Wilder once suggested that the remuneration might be increased a trifle, he was reminded by one of the owners that it was a "steady" job with no lost time. Between firings he learned to do carpenter, millwright and steam fitting work and was on the road to becoming a plumber, glazier, and brick mason when he decided to make a change.

In the following years, Mr. Wilder accumulated valuable experience in the plants of the National Biscuit Co., the E. W. Gibson Co., the Ne Plus Ultra Yeast Co., and the Royal Worcester Co. At twenty-four, he was placed in charge of a large rolling mill engine at the American Steel & Wire Co., and two years later was made chief engineer of the Ettick Mills at Auburn, where he remained for 14 yr. Under his direction, this plant was changed from simple, noncondensing to compound condensing operation. Hot water, heated by exhaust steam between the low-pressure cylinder and condenser, was introduced in place of live steam for heating. All returns, which formerly had to be thrown away, were brought back and the feedwater temperature raised from 130 to 230 deg. F.

Two years ago, he was appointed chief engineer for the Assabet Mills of the American Woolen Co. and was last year promoted to take charge of their Washington Mills at Lawrence.

Like many others of the old school, Mr. Wilder is an untiring worker. This summer he took the first vacation that he has had in seventeen years. To be successful in the handling of men he believes that chief engineer or superintendent must treat his men as he *would* be treated and not as he *was* treated. Wilder has been a loyal member of the N. A. S. E. for about twenty years and is also active in the work of the Engineers Blue Room Club of Boston.

WHILE the world is justly exercised over the rapid consumption of its supply of coal, it must not be forgotten that the deposits of peat and lignite are sufficient to keep us supplied with fuel for ages to come. To be sure, these inferior fuels are not in proper shape for consumption, but our chemists and engineers must find methods of preparation and combustion which will render them suitable to our needs. Already the Bureau of Mines has taken up the investigation of the lignites with a view to partial substitution for bituminous coal. It is not too much to predict that within a comparatively short time the brown coals of the Northwest will have become commercially valuable and that means will have been found to relieve our anxiety as to the fuel supply of the future.—Steam.

New Hydroelectric Plant in Operation

THE FIRST GREAT HYDROELECTRIC PROJECT BUILT SINCE SIGNING OF ARMISTICE, COMPLETED IN RECORD TIME. BY CHARLES W. GEIGER

ON AUGUST 15, the Kerckhoff hydroelectric project of the San Joaquin Light and Power Corporation on the San Joaquin River near Auberry, California, was put in operation and power supplied to consumers. This plant which has a maximum capacity of 50,000 hp. was constructed at a cost of over $5,000,000 and is said to be the first project of its kind in the United States begun, finally completed, and placed in operation since the signing of the armistice.

The new power project is being hailed with joy throughout the San Joaquin valley because it relieves the electric power shortage which has prevailed there since the war, due to the inability to supply additional electric power as fast as the demand for it grew. This condition was brought about by the unprecedented demand for new farm properties entirely dependent upon electric power for pumping water for irrigation purposes.

The new plant also will greatly relieve the gasoline shortage at present prevailing. Hundreds of farmers who found themselves unable to obtain electric power for their pumping plants this year, installed gasoline engines to pump water with, or else operated their pumps by means of traction engines. A heavy demand for gasoline accordingly arose from this source. The San Joaquin Light and Power Corporation is now connecting up all pumping plants and oil well pumping plants on the regular priority of service list as speedily as possible.

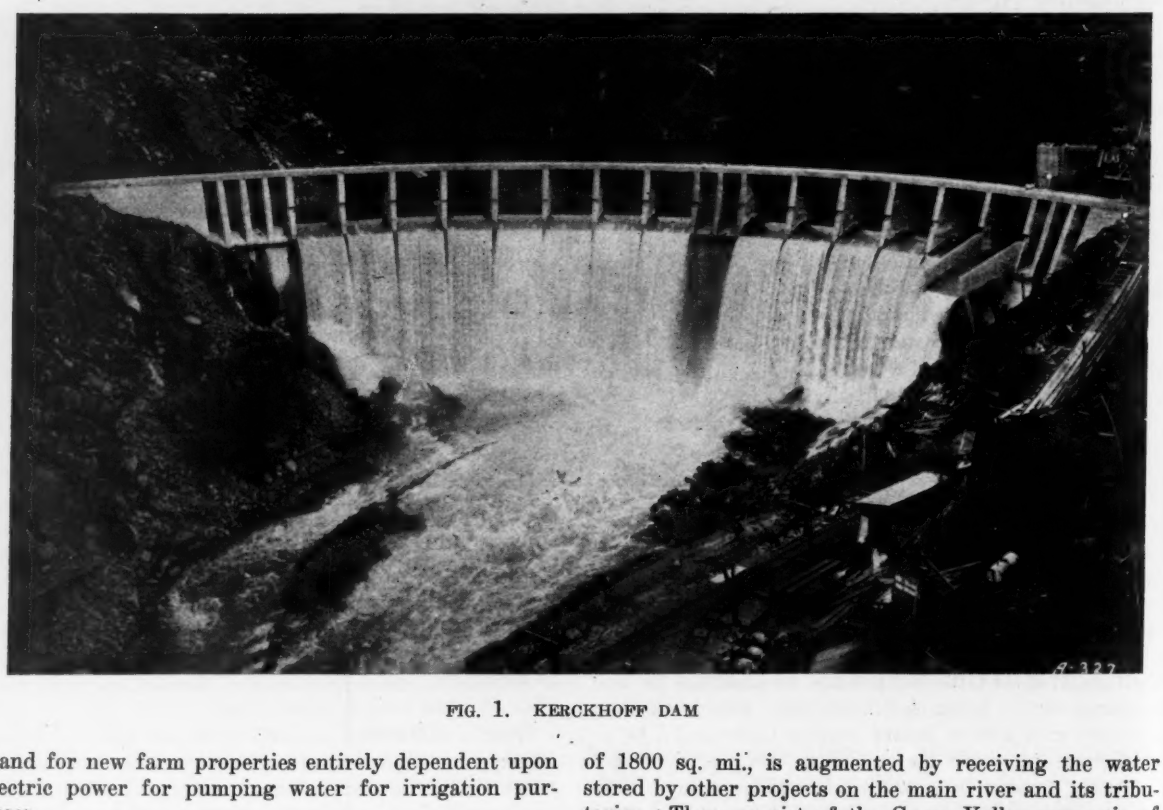


FIG. 1. KERCKHOFF DAM

DAMS AND TUNNEL CONSTRUCTION

THE OUTSTANDING feature of the Kerckhoff project is a constant angle arched dam across the San Joaquin River. It forms a small storage reservoir, with a capacity of about 8000 acre-ft., in the form of a lake, known as Kerckhoff Lake, 3½ mi. in length. The dam diverts the entire flow of the San Joaquin River through a tunnel line 18 ft. by 18 ft. in dimension. This tunnel line is 17,000 ft. long and has been driven through a mountain of solid granite. It terminates 365 ft. above the water of the river, where, by means of three 8-ft. steel pipe penstock lines, it is dropped onto the generator units in the power house. The tunnel line has a capacity of more than 1500 cu. ft. per sec. At this point, the natural flow of the San Joaquin River, with a drainage of 1800 sq. mi., is augmented by receiving the water stored by other projects on the main river and its tributaries. These consist of the Crane Valley reservoir of the San Joaquin Light and Power Corporation and Huntington Lake reservoir of the Southern California Edison Co. Future developments at Shaver Lake, Florence Lake, Blaney Meadows and Vermilion Valley by the Southern California Edison Co. will increase the mountain storage of water along the San Joaquin by 300,000 acre-ft.

COMPLETED IN RECORD TIME

KERCKHOFF DAM was built in 104 days. It is about 125 ft. in height, 100 ft. long at the base, 40 ft. thick

and contains 24,500 cu. yd. of concrete. At the top it is 570 ft. in length. Many obstacles have been overcome by engineers in erecting the dam because of the steep box canyon in which it is located. Air compressors, building materials and other supplies for the initial work had to be snaked down a precipitous mountainside by mule team. Later an inclined railway, operated by a 100-hp. motor-driven hoist, was installed. In descending 1100 ft. in altitude, this incline is 2800 ft. in length and has a maximum grade of 92½ per cent.

Steam shovels operated by compressed aid and electric railways laid in the floor of the tunnel are responsible for a record-breaking feat in tunnel construction. In order to facilitate the work the 17,000 ft. of tunnel was divided up into four sections and it was driven from five separate headings. Each heading was equipped with air drills, steam shovels and electric trains. Operations were begun June 6, 1919, and were completed July 27, 1920. In all of this time work never ceased in the five different headings. Miners worked every hour of the night and day. Owing to the huge size of the tunnel, the muck was handled in this manner at a greatly reduced cost and, although the costs of operation were high, the time in driving and the final unit costs were also greatly reduced.

Power House Features

The power equipment consists of three 15,000-hp. Frances type turbines, direct connected to 60-cycle, 3-phase alternating-current generators. The units are of the vertical type and a feature of their construction is the use of the latest type of Kingsbury thrust bearings, mounted on top of the shaft and supporting the entire weight of the rotating part, as well as taking up the thrust of the runner, due to the water passing through the wheel. This method is considered very much more efficient and economical and is being used for the first time in the Kerckhoff machines.

Latest type out-of-door transformer and switching equipment is installed. Current is delivered from the power house at 110,000 v. over a new high-tension transmission line built especially to receive it. Sub-stations have been erected at Sanger, Corcoran and McKittrick, where the high voltage is reduced for distribution throughout the service lines.

Transportation Problem

One of the most serious problems to be overcome in a big development work of this kind is that of transporting materials and supplies. The location for dams and power houses in hydroelectric projects makes necessary construction of steep and dangerous grades which add to transportation difficulties. Almost 15 mi. of precipitous mountain grade had to be constructed to reach both the dam and the power house. Batteries of automobile trucks were used to transport supplies to the tops of the mountains overlooking both the dam and power-house sites, and from here they were lowered to the scenes of operation by means of inclined railways. The heaviest power-house machinery was handled by a caterpillar traction engine drawing a gun carriage having steel wheels 60 in. in diameter. The heaviest piece of equipment handled by it weighed 58,000 lb. and was hauled a distance of 5½ mi. in 4 hr., which includes the time taken to load and unload the trailer.

Second New Plant

The Kerckhoff project with 50,000 hp., is the second big electric generating plant the San Joaquin Light and Power Corporation has completed so far during the present year. Last month, a 17,500-hp. natural gas burning steam generating unit was placed in the huge steam plant at Bakersfield. This makes a total of 67,500 hp. in new generating capacity added to the system of the San Joaquin to date in 1920.

So great is the demand for electricity in the San Joaquin Valley that the applications for service now on file will immediately absorb all of this generating capacity just as soon as line extensions can be built to serve it. The company has already ordered the equipment for the first 17,500-hp. unit of a new natural gas burning steam generating plant to be erected near the new Elk Hills gas fields in Kern County to supply next year's new business. This plant will be enlarged until it contains at least four such units, with a total output of 70,000 hp.

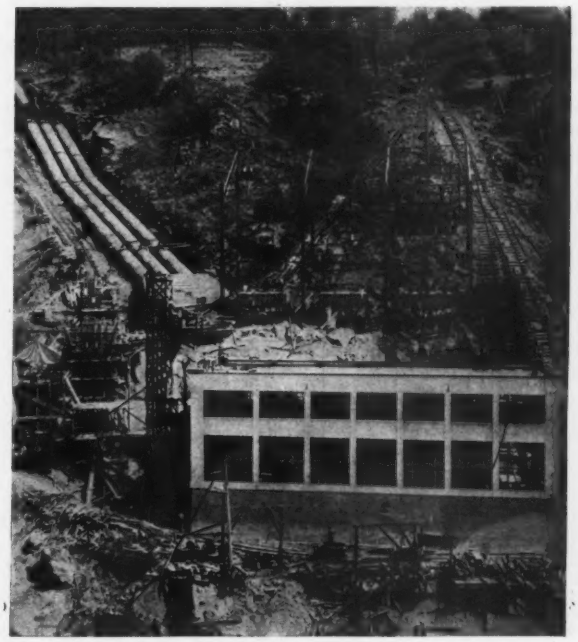


FIG. 2. THE NEW POWER PLANT SHOWING THE THREE 8-FT. STEEL PENSTOCKS TO GENERATORS

The company is also doing its preliminary work on the development of approximately 300,000 hp. on the north fork of the Kings River by a series of seven separate power houses.

Any problem can be solved if you have the accurate data. Make sure you have the facts; then you can command any situation if you work at it hard enough and long enough.—Herbert Hoover.

"Up in the air does not mean total lack of control; ask the aviator. Nor does every sprinter go the pace that kills; ask the athlete."

Sawmill Refuse as Fuel*

CHARACTERISTICS OF WOODS AVAILABLE AND FURNACE CONSTRUCTION REQUIRED. BY DARRAH CORBET

ON ACCOUNT of the recent rapid increase in the costs of coal and oil fuel, there has been a strong tendency, particularly on the Pacific Coast, toward the use of sawmill refuse as fuel. This fuel, which is probably available in larger quantities in the Northwestern territory than in any other part of the world, contains wood of every kind and size, from the finest dust to chunks and blocks as large, probably, as a 12-in. cube.

There is available as refuse from sawmills a great variety of woods. In some respects, these woods are similar; but there is a great variation in some of their characteristics, particularly as regards the moisture content.

The fuel value of woods varies considerably, due to the amount of resin present. In general, the woods ordinarily encountered in the Northwest territory do not contain large percentages of resin; however, some of them do contain certain percentages and consideration must be given to this in considering the fuel value of the refuse. Long-leaf pine encountered in Florida or the Southern Gulf Coast probably contains a larger percentage of resinous matter than any other woods in this country, in certain cases as high as 50 per cent. As the calculated calorific value of resin is about two

TABEL I. ULTIMATE ANALYSIS OF WOOD

	Per cent Carbon	Per cent Hydrogen	Per cent Oxygen	Per cent Nitrogen	Per cent Ash	B.T.U. per lb.
Ash	49.18	6.27	43.91	0.07	0.57	8480
Beech	49.06	6.11	44.17	0.09	0.57	8591
Elm	48.89	6.20	44.25	0.16	0.50	8510
Oak	50.16	6.02	43.36	0.09	0.37	8316
Fir	50.36	5.92	43.39	0.05	0.28	9063
Pine	50.31	6.20	43.08	0.04	0.37	9153

times that of wood, it is evident that the resin present has considerable influence on the heating value.

The other woods whose calorific value varies according to the amount of oil and resin they contain are short-leaf pine, loblolly pine, Western yellow pine, pinion pine, pitch pine, cedar, fir, juniper, cypress, etc.

It is interesting to note that non-resinous woods from an ultimate analysis are shown to contain about 50 per cent of carbon and the other parts principally hydrogen and oxygen in the proportions which burn to water. An analysis of woods most generally referred to is as shown in Table I.

Sawmill refuse as we ordinarily secure it is seldom if ever segregated so as to contain but one class of fuel. The moisture content of the refuse is also a variable item due to the fact that the refuse may come from not only the different kinds of woods but from different parts of the manufacturing plant where they may be handling wet or kiln-dried lumber. Then, in addition, a large amount of moisture is added to the sawdust from some of the saws, particularly large band saws where water is kept running on the saw in order to keep it cool and assist in the cutting.

Many analyses have been made of the heat content of various samples of sawmill refuse fuel, some of which are given in an accompanying table.

UNIT OF FUEL

REFERENCE HAS been made to a "unit" of fuel and as the definition of such a unit of fuel is frequently asked, an explanation at this time is in order. The Grays Harbor Railway & Light Co. plant at Aberdeen, Washington, was the first electrical generating station of material size designed to use sawmill refuse as a fuel. When the people operating the plant went out into the market to buy fuel, it became necessary for them to arrive at some unit as the basis of measure. Some experiments were made by putting a cord of slab wood through a hog and measuring the resulting fuel and although this seemed to indicate that approximately 177 cu. ft. of hog fuel was the equivalent of a cord of wood before being put through the hog, there was established the standard of 200 cu. ft. as the measure of refuse and this was designated as a unit.

There is considerable variation in the weight of a unit of fuel, due partly to the moisture content and partly to the settling of the fuel if it is allowed to stand for any length of time, particularly when subject to a superimposed load.

STORING WASTE WOOD

ON ACCOUNT of the difficulty of storing the fuel in houses large quantities have recently been stored in the open and later reclaimed for fuel use. The two largest storages at present consist of the one at Station "L" of the Portland Railway, Light & Power Co. and at the plant of the Northwestern Electric Co., both at Portland, Oregon. It is really not expensive to store fuel in this manner if ground space is not too valuable. The fuel is moved with specially designed rakes and in a well designed installation but little labor is necessary.

There is unquestionably some depreciation in the fuel value of mill refuse when stored, particularly in the open for a material length of time. This, however, amounts to but little under ordinary circumstances. I have heard of one or two instances where fuel of this kind has been recovered after years of lying out in the open and with its use satisfactory steaming of the boilers was secured. At least, one sample of fuel having been stored 8 mo. in the open was analyzed by the Portland Railway, Light & Power Co. which seemed to indicate that there was a large increase in the moisture content of the fuel, some slight increase in the amount of ash and a little falling off in the B.t.u. per pound dry fuel, doubtless due to the ash present. The writer is not certain as to just how this sample was selected, but it is certainly not always the case that in storing fuel the moisture content is increased, as in many cases the fuel is dried out somewhat as lumber is air dried. In drying out in this manner, a certain portion of the water is quickly given off, particularly if atmospheric conditions are at all favorable. The evaporation then slows up suddenly and a considerable amount of moisture is retained.

*Abstract of paper read before Pacific Coast Convention of the A. I. E. E

The Furnace

The type of furnace for sawmill refuse fuel is a matter that should receive most careful attention.

There are, however, a few fundamental features in the design of the furnace which from analyses and from experience evidently are correct. Although it is quite probable that as good or possibly better efficiencies could be secured from hand firing, the great majority of installations feed the fuel to the furnace in a more or less continuous stream, the fuel being delivered through a hole in the top of the furnace to pile up in a cone on the grates. This method of firing is much the most simple and economical from a labor standpoint, one man being able to take care of several thousand horsepower of boilers in a properly designed plant.

Considering fuel to be delivered to the furnace in the continuous manner referred to above, then one can readily see that in order to expose the greatest possible amount of surface of the cone for burning and yet to prevent excessive infiltration of air through the grates, each fuel pile should cover practically a square section of grate. Experience has indicated also that this is essential for the best operating conditions. If additional grate surface is desired in front of a boiler, then the furnace can be so designed that there will be two fuel piles per furnace, the piles being arranged in tandem, and the grates practically twice as long as they are wide.

A furnace approximately 6 ft. wide is ideal; but in many installations it is impossible to secure ideal conditions and therefore furnaces have to be designed, many of them operating entirely satisfactorily, which vary widely from the above specified width. It is probable that a reduction in the width of the furnace is more serious than an increase from the figure referred to and as a matter of fact it is quite possible, and many satisfactory installations have been made, where furnaces are as much as 12 ft. wide; but in such cases, the grates are covered by at least two fuel holes across the width of the furnace. There are some structural difficulties in making a furnace wide, as that of the support of the fire brick arch, which should be over the top of the grates.

Experience has indicated that with any type of fuel, furnace temperatures can be varied by changing the area through the throat of the furnace. Any tendency to bottle up the furnace results in a material increase in furnace temperatures. High temperatures are desirable for burning ordinary sawmill refuse and this bottling effect can be and is secured and most advantageously by running the bridge wall up to such a point as will give the desired temperatures without interfering materially with the draft. The furnace should be surrounded on the top and sides with incandescent fire brick. The reflected heat aids in the combustion of the fuel and the distillation of the moisture present.

The area through the throat of the furnace is a variable quantity and should be figured out carefully for the installation. In general, the area through the throat of the furnace should be from 6 to 14 sq. in. per rated boiler horsepower, depending upon fuel conditions, design of furnace, the rating which is to be expected, and the available draft.

The question of proper admission of air to the furnace is a matter of importance. As combustion is mostly on the surface of the cones of fuel the air should be available at these points. It is undesirable to have excess air with this class of fuel as with any other. In some installations it has been found desirable to keep the fuel holes at the top of the furnace open for the admission of air and in other installations far better results are secured by closing these by one means or another. As with almost every class of fuel slight adjustments are necessary after the plant is put into operation.

Analyses of this class of fuel that have been made indicate that they contain a large percentage of volatile. It can readily be understood that this will be quickly distilled off in a hot furnace and in addition much of the finer fuel is quickly carried with the force of the draft out of the furnace. These conditions make it highly desirable that the installation be provided with a combustion space back of the furnace and before the heating surface of the boiler is reached, in order that this unconsumed fuel can have an opportunity to burn before it reaches the heating surface of the boiler. In

TABLE II. ANALYSIS OF HOG FUEL SAMPLES

Sample No.	Per-cent moisture	Per-cent volatile	Per-cent fixed carbon	Per-cent ash	B.T.U. Per pound dry fuel	Per-cent carbon	Per-cent hydro-gen	Per-cent oxygen
1	62.85	81.70	18.06	.24	9010	. ..	...	.....
2	47.9	39.7	11.7	0.7	8970	.....	...	.. ..
3	27.6	56.4	14.9	1.1	8800	.....	....	.....
4	36.1	49.1	14.0	0.8	8740	.....	....	.....
5	34.17	....	.....	0.78	8342	45.61	6.14	47.05
6	21.94	. .	.....	0.05	8586	47.03	6.56	46.36
7	42.26	...	... .	0.44	8682	.....	....	.....
8	48.83	....	... .	0.56	8193	.....	....	.....
9	40.28	....	....	0.35	8039	46.75	5.81	46.84

1. Mixed refuse from Yosemite Lumber Co.
2. Average mixed fuel, Portland territory.
3. Average fuel from manufacturing plant (using kiln dried material (Portland territory)
4. Average mixed fuel from lumber mill, Portland territory
5. Sawdust from first cut average fir log, Grays Harbor territory
6. Sawdust from heart clear fir logs, Grays Harbor territory
7. Mixed fuel from sawmill, Grays Harbor territory
8. Mixed Spruce refuse, Grays Harbor Territory.
9. Sawdust from clear spruce logs, Grays Harbor territory.

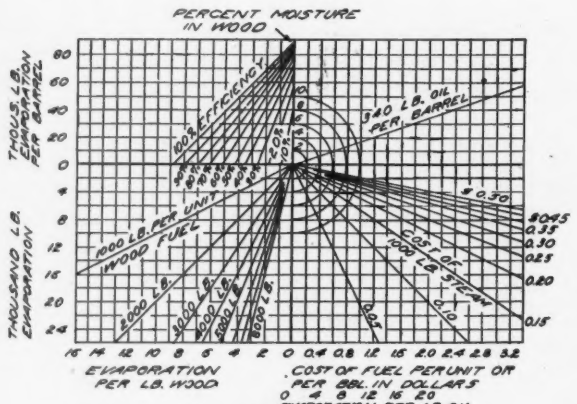
this combustion space, there should be tuyeres and a door or damper to control the admission of air to them. In this manner, supplementary air is added at this point and combustion conditions are materially improved. In general, the most convenient place for the admission of this secondary air for combustion is through the bridge wall. Experiments have indicated that the most satisfactory place for admitting the air is either on the top of the bridge wall or on the back face of it. On the top of the bridge wall, the air can be admitted through grate bars and on the back face of the bridge wall through openings made by leaving out a brick now and then. The difficulty with the opening on the top of the bridge wall is that it may become clogged with soot or ash and it permits this matter to sift down into the space below.

Under any circumstances, for the most efficient conditions, the arch of the furnace should extend beyond the point where the supplementary air is admitted, as this arrangement brings the gases and the air most intimately in contact with each other.

The height of the arch above the grate is a factor depending upon the width of the furnace and the kind of fuel to be handled. The height of the arch determines in a great measure how hot the arch will be. Experi-

ments have indicated that a change in the height of the arch of a foot or even less will change the temperature of the arch so much that the effect upon combustion is very marked. In general, the arch is approximately 5 to 7 ft. above the surface of the grates. In a wide furnace it will, of course, be necessary to have two fuel holes across the width of the furnace in order to cover the grates from this height.

It is desirable to secure a grate with as large a percentage of air space as possible and yet have the bar strong enough to stand up under the rather severe conditions encountered with this fuel. Smaller bars are preferable, due to the fact that in overheating they will not warp so far out of line as a longer bar and are less expensive to replace. Width of air opening in the grate is very important and depends upon the class of fuel to be handled. Where there is a great deal of fine sawdust, of course, the width of air space should be less. With coarser fuels, the width can be increased. It seems that practically always there is a certain amount of fuel that falls through the grates and this should be prevented as far as possible. Experience has seemed to indicate that the width of the air space should not be more than ½ in. and in a great majority of cases less than this. The writer has never seen any experiments made with sawmill refuse fuel on shaking grates; but on account of the very large percentage of air space (35 per cent or more) which can be secured with this type of grate and with an air opening not to exceed ½ in., we believe that this grate in a properly designed installation would readily pay for itself. It would be particularly easy to keep such a grate clean. Ordinarily there is a certain amount of dirt fed into the furnace with the sawmill refuse which collects on the grate surface and periodically has to be removed.



CURVE OF COMPARATIVE VALUES OF WOOD AND OIL FUEL

In the majority of plants, the ash pit below the grate is comparatively shallow, and the fuel which sifts through the grates, on account of the high temperature, readily burns and great difficulty is experienced in making grate bars and bearers stand up under these severe conditions. Practically all installations are provided with some means or other for flooding the ash pit or quenching fire in the ash pit with a hose or other means of that kind. Water in the ash pits unquestionably helps to keep the grates cool and adds to their life.

Stack Capacities

We can probably figure a little less stack area for sawmill refuse fuel than is figured for coal. However, sufficient information has not been secured as yet so that no definite figure can be given. On the other hand, with the average installation, the owner is always desirous of getting large overhead capacities out of his installation and to assist in this it is desirable to have tall chimneys. When one realizes that the capacity of an installation is dependent in a large measure upon the stack capacity it is readily realized that a little bit of additional money spent for a larger chimney is well invested.

In the average sawmill plant, at least one or more boilers are shut down over the week-end for washing out. Where steel stacks are used there is a distinct advantage of having one stack for a battery of two boilers, due in a large measure to the fact that with such an installation it is always possible to keep one boiler of the battery in operation over the week-end and keep the stack hot and prevent to a degree the corroding action which seems to be quite marked in steel stacks where sawmill refuse is used.

Oil vs. Sawmill Waste

The majority of power plants on the Pacific Coast are at present using oil fuel and in order to indicate the comparative results that might be expected with sawmill refuse and oil fuel the writer has made up a set of curves for this purpose. On the sheet is indicated the assumptions that have been made and as the B.t.u. value of dry wood is quite uniform it is probable that the assumptions are not greatly in variance with the average conditions.

It is to be noted that the evaporation per pound of wood as shown by the curves is based upon the available heat in the wood as calculated. There are various ways of stating efficiencies and this particular matter should not be confused. Efficiencies can be stated on the basis of the total heat per pound of fuel as determined by a calorimeter; upon the total heat of a pound of dry wood as determined by a calorimeter; upon a pound of combustible; upon the available heat as shown by a calorimeter or upon available heat as calculated from the total heat of a pound of dry wood. This latter method is quite satisfactory and applicable in the majority of cases.

As an explanation of the use of the curve, we can assume the following conditions and follow through a determination: Oil $1 a barrel, 12 lb. evaporation per pound of oil; sawmill refuse fuel containing 45 per cent moisture, weighing 20 lb. per cubic foot; efficiency, 60 per cent. The problem is to determine what can be paid for sawmill refuse fuel per unit to equal the fuel value of oil at the price stated.

Starting with the value of 12 lb. of evaporation per pound of oil, directly above this at the point of intersection with the line indicating the pounds of oil per barrel we note that on the left the total evaporation per

barrel of oil is 4080 lb. Transferring this below the line as indicated by the semicircle and carrying 4080 lb. evaporation across to the right we note that under the figure $1 per barrel, the cost of 1000 lb. of steam is about 24½ cents.

Starting again with 45 per cent moisture in the sawmill fuel and going to the left to the point of intersection of 60 per cent efficiency we note that the evaporation per pound of wood is approximately 2.3 lb. water, or with 4000 lb. per unit this is equivalent to about 9200 lb. of water per unit of fuel. Carrying this to the right to the point of intersection with the line indicating cost of steam 24½ cents per 1000 lb., we note $2.25 as the equivalent cost of a unit of fuel.

On the same basis, if oil cost $2 a barrel the equivalent cost of sawmill refuse would be twice the foregoing, or $4.50 a unit. In this manner a ready reference is secured and the curve can probably be read far more accurately than will be the assumptions made.

There has not been a very extensive use of sawmill refuse fuel in power plants, up to the present time, due to the fuel being so bulky and inconvenient for handling in large quantities, and also because other fuels have been available at prices which made them more attractive. However, recent heavy advances in the cost of coal and oil have driven a few concerns to the use of sawmill refuse. Besides the other large consumers referred to in this article, attention is called to the fact that quite a number of small users are not relying upon sawmill refuse which is delivered to them in trucks. Such plants are laundries and the like where the boiler installations are not large.

It is interesting to note that the Portland Railway, Light & Power Co. has secured very satisfactory results with the use of sawmill refuse fuel on Riley stokers. The fuel fed through the retorts of the stoker is supplemented with additional fuel fed from overhead chutes. Although one can readily understand that the installation of stokers for sawmill refuse fuel would not be warranted, nevertheless, that this class of fuel can be burned on a stoker with satisfactory results makes it possible to shift quickly from coal to mill refuse or back again as the case may require.

Larry, the Storm Observer

By John S. Carpenter

LARRY, the storm observer for a large East-coast power plant, was once a sailor. We can't hold that against him, or the fact that he has a slightly rolling gait, for he radiates good fellowship to everybody and everybody likes him. But that's not the reason that I'm writing all this.

His Chief says Larry is a star. A star at locating and keeping tab on storms. In these days when fuel of any kind is nearly as precious as the stuff they keep in well-kept cellars, it is important to watch storms that may mean 50,000 kw. extra load inside of a few minutes. It means something to throw maximum capacity suddenly on a battery of boilers that are slumbering along on banked fires. But Larry says watching storms and getting the dope on them is only common sense, and the Chief observed that "common sense was often the least common of all the senses."

When Larry took me into his "parlor," he said, "Now don't go an' give the boys a lotta guff, tell 'em the truth."

Which I solemnly swore to do. In one corner of his little cabin, were a lot of scientific apparatus such as a recording barometer, wind gage, etc. I noticed that none of them were working. Larry saw me looking at them and says, "Yes, they ain't on the job now, I don't need them and also don't know if they's meant to tell weather with or is used for playin' billiards. My predecessor got 'em in and shortly after went into the aeroplane business."

On the other side of the room I saw a telephone, a map of the surrounding country, a pad of paper and pencil and a nautical almanac. Beside the formidable array on the other side, this looked commonplace. But Larry said it had the other stuff beat forty ways.

"Tell me, Larry, how you do it so well, so I can tell the boys who read Power Plant Engineering, that is, if there's no secrets about it."

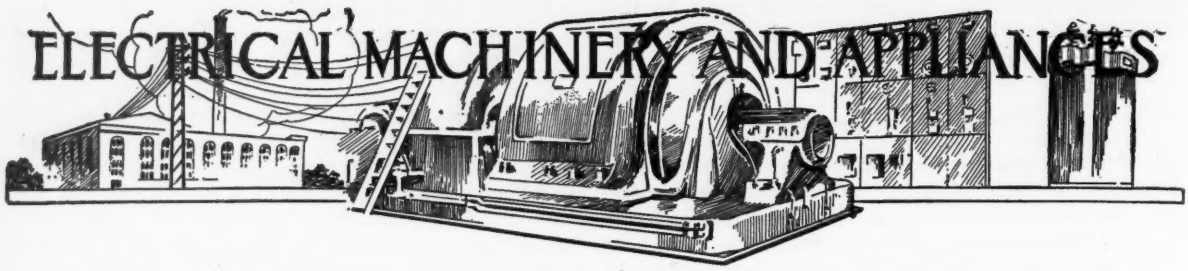
Larry took the cigar I offered, lit it and blew the smoke skyward. "Quite tony with your smokes, hey?"

"Well, it's like this. I have a map here of the surrounding country with the north point set with the magnetic north. When I see a dark cloud in the offing, I locate it by direction on my map.

"I keep my eye on the cloud and watch its course and rate of speed. All this I keep plotting on my map which is shellaced so I can rub off the soft pencil marks. The minute I see any flashes I get out my watch and begin timing until I hear the thunder. Sound travels about 1100 ft. per second in the warm air of summer. This map here is marked off in circles, with the plant as the center, in one second circles, that is 1100 ft. apart. By the observed direction and the timing I can spot a storm center darn quick on the map. It may be a small storm, that is covering a small area, or it may be a big one. I now have one observation. Pretty soon more will be coming of different timing and direction. Then I plot those points and soon get an idea of the space it covers. From then on, I keep in pretty near constant touch by telephone with one of the operators at the switchboard and he is in touch with the fire-room boss and the turbine men. Our transmission lines cover quite a bit of territory. The thing now is to find out how it is traveling and from its rate of speed, that is, distance divided by speed, I can tell how soon the center will reach us. The operator is always getting this kind of dope from me and also whether the storm is passing off or getting worse. He can tell from this whether to start up more units or take them off."

"But," I said, "what is the nautical almanac for?"

"Somehow, storms have a likin' to break at high tide or close to it. I s'pose it's the high local atmospheric pressure at high tide, caused by so much water surface lifting up. This table I got here is corrected for time to the plant and I write down on my pad every day the time of high tides. If there is any tendency to clouds I can usually guess when the festivities will begin. Sometimes a storm cloud will hang over a place all day and not seem to budge an inch. My methods is rough, and maybe not so scientific as others use, but the Chief will tell you that we don't often get caught asleep." Larry looked over to the Chief and smiled.



A Study of Dynamo Electric Machinery---XIX

SINGLE-PHASE MOTORS AND THEIR CHARACTERISTICS. BY OTTOMAR H. HENSCHEL

SINGLE-PHASE alternating-current motors may be of the induction, repulsion, the repulsion starting and induction running or the series type. The straight single-phase induction motor, unless provided with a phase-slitting device or a shading coil, develops no starting torque when its rotor is not revolving, and as a consequence occupies but an exceedingly limited field. With the use of a phase-splitting device or a shading coil, this disadvantage is, however, eliminated.

Where split-phase starting is employed, the motor is fitted with two distinct windings, displaced as shown in Fig. 137, 90 deg., and known as the starting winding and the running winding. The starting winding circuit is so arranged as to possess considerably more inductance, capacity or resistance than the running winding, with the result that a rotating magnetic field is created and the rotor enabled to start. After the rotor has reached synchronous speed, the starting winding is cut out of circuit, this operation is generally accomplished automatically by means of a centrifugal switch embodied within the revolving member.

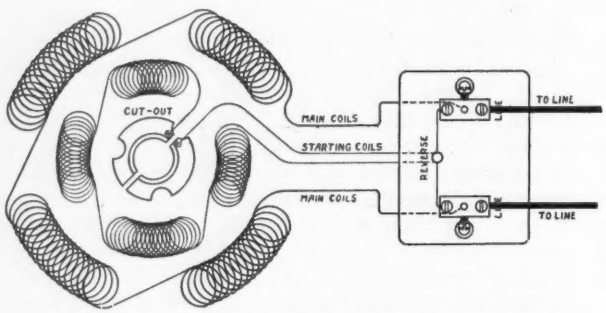


FIG. 137. SINGLE-PHASE MOTOR ARRANGED FOR SPLIT-PHASE STARTING

Motors designed for starting on the shading coil principle have their pole pieces fitted with short-circuited bar windings in the manner indicated in Fig. 138. The flux created by the flow of alternating current through the main winding passes through the pole pieces and induces in the shading coils a secondary current, the resulting magnetic field of which tends to oppose that portion of the pole flux producing it. Due to the fact that therefore the flux in the unshaded portion of the pole pieces renders its maximum value at a different instant from that emanating from the shaded portion, and the displacement of the two halves of the pole pieces, a revolving magnetic field is established, thus enabling the motor to pick up speed.

This scheme, like that of the split-phase arrangement, is applied only to motors of fractional horsepower capacity.

Due to their very nature, and as their name implies, induction motors tend to draw a lagging line current. As a result, and especially where many small and underloaded induction motors are installed, extremely low lagging power factors will be encountered. To eliminate this trouble and not only improve the lagging power factor, but also to provide a machine drawing a leading line current, one manufacturer has placed on the market a so-called unity power factor motor. This machine,

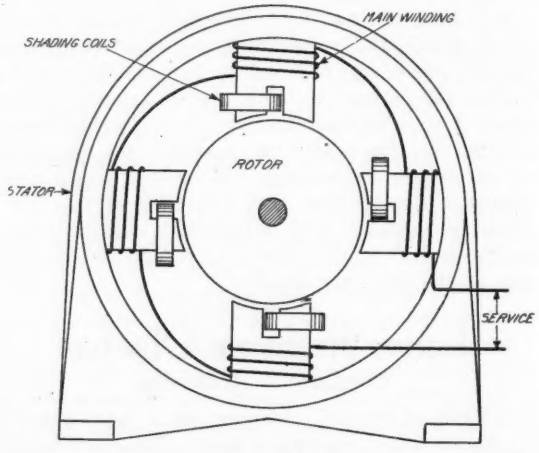


FIG. 138. METHOD OF USING SHADING COILS FOR STARTING SINGLE-PHASE MOTORS

which is self-starting, without clutches or other auxiliary devices, is said to possess approximately unity power factor at full load, with leading power factors at loads from zero to 100 per cent of rating.

An elementary diagram of connections of this type of motor is shown in Fig. 139. Two windings, a main and a compensating winding, are employed, the former used to produce the main field flux, while the compensating winding is utilized exclusively for the control of the power factor.

The main winding is of the usual squirrel-cage construction and occupies the bottom of the slots, while the

auxiliary winding occupies the space above, a magnetic separator made of soft rolled steel bar being placed between the two. The auxiliary winding is connected to a standard form of horizontal commutator, which in turn is provided with two sets of brushes. One of these, the main pair, is placed in the axis of the main stator winding and is intereonnected, giving repulsion motor characteristics; the auxiliary pair of brushes is placed at right angles to the main stator winding and is connected in series with it. The auxiliary stator winding is arranged to be automatically connected in parallel with the auxiliary brushes at a predetermined speed, and while this connection improves the power factor and the speed characteristics, it is not essential

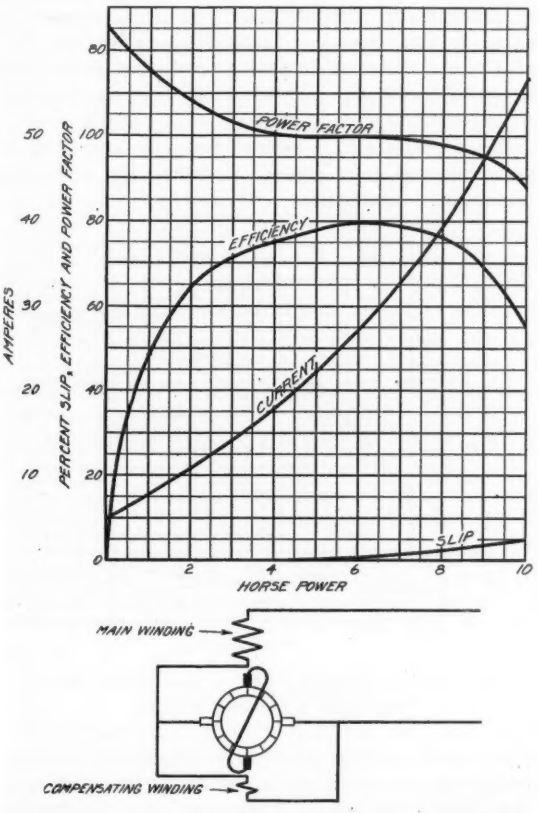


FIG. 139. ELEMENTARY DIAGRAM OF CONNECTIONS AND CHARACTERISTICS OF A UNITY POWER FACTOR MOTOR

to the operation of the motor. Should the automatic switch fail to close, the machine would still operate satisfactorily but with reduced power factor and efficiency. The result of this action is shown in Fig. 140. The machine will operate and carry full load if, after the motor has reached rated speed, all the brushes were removed. It would then operate as a squirrel-cage induction motor with characteristics as shown in Fig. 141.

Motors of this type are particularly well adapted for service requiring power factor correction, and on account of their inherent torque and speed characteristics are many times preferable to the synchronous motor.

An alternating-current motor which, like the series-wound direct-current motor, possesses high starting torque with increasing speed, is the straight induction motor. This motor, which is well adapted to such service as the driving of fans, printing presses, blowers and other machines requiring a constant torque, has power factor characteristics more nearly approaching unity than the induction motor.

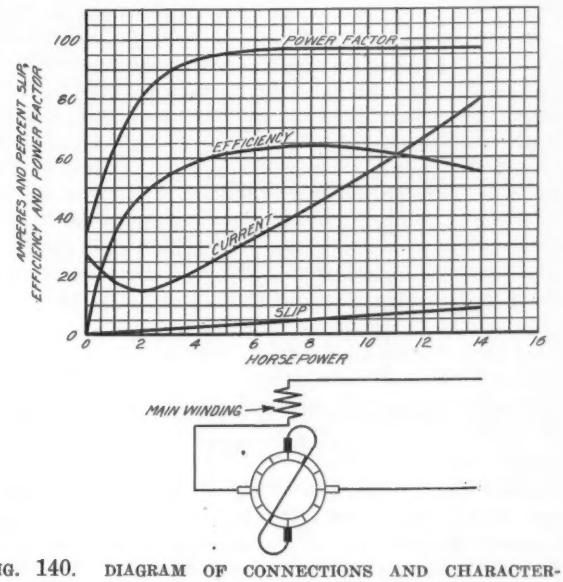


FIG. 140. DIAGRAM OF CONNECTIONS AND CHARACTERISTICS OF UNITY POWER FACTOR MOTOR WITH COMPENSATING WINDINGS DISCONNECTED

In the repulsion induction machine, two windings, a main winding and a compensating winding, are employed, the latter connected as shown in Fig. 142 to compensating brushes bearing upon the commutator in

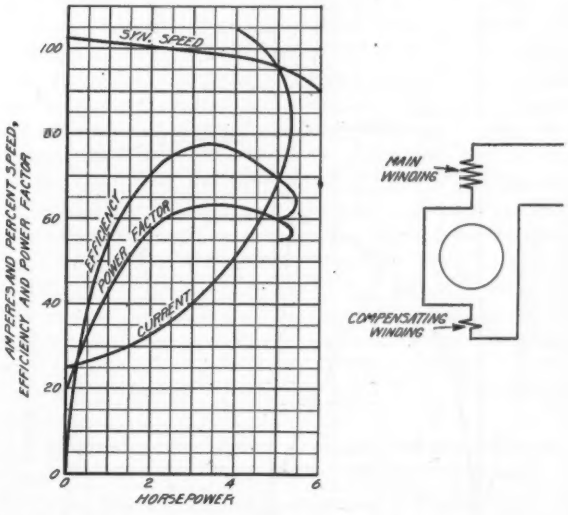


FIG. 141. DIAGRAM OF CONNECTIONS AND CHARACTERISTICS OF UNITY POWER FACTOR MOTOR WHEN ALL BRUSHES ARE REMOVED

the manner indicated. A second or energy set of brushes having approximately the same angular position in relation to the stator winding as the energy brushes of the straight repulsion motor are also employed.

Efficiency, power factor and speed-torque curves

shown herewith graphically illustrate the operating characteristic of a typical repulsion induction machine. The starting torque of a motor of 5 hp. rated capacity and less is 250 per cent of full load torque at all frequencies and of machines of 7½ hp. and more 200 per cent of full load torque. The maximum running torque is about 300 per cent of the starting torque, and as a consequence the motor will accelerate any load it will start.

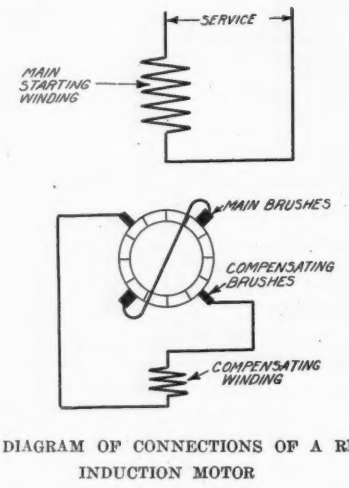


FIG. 142. DIAGRAM OF CONNECTIONS OF A REPULSION-INDUCTION MOTOR

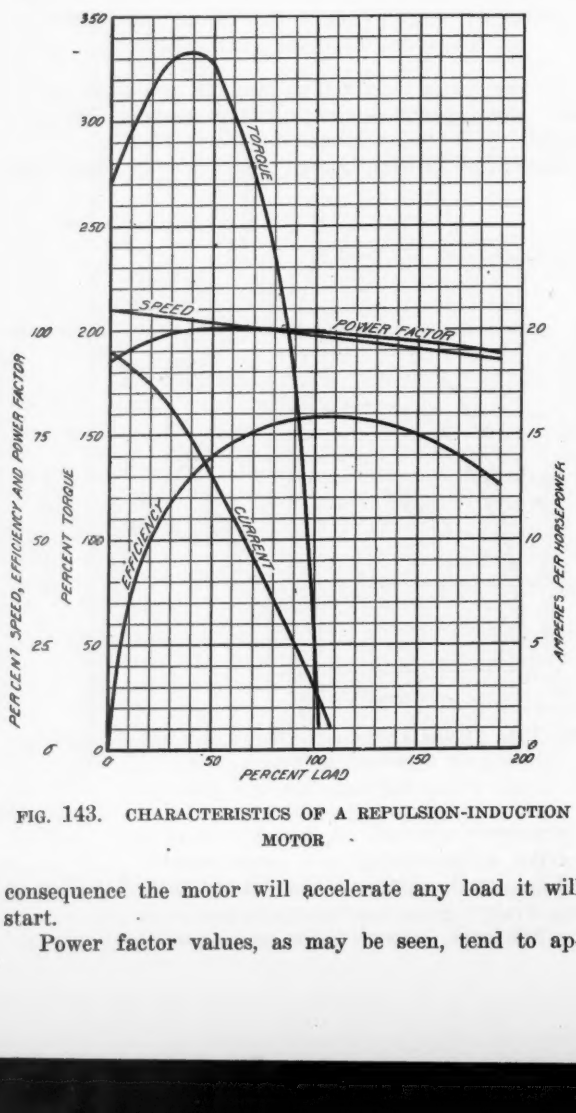


FIG. 143. CHARACTERISTICS OF A REPULSION-INDUCTION MOTOR

Power factor values, as may be seen, tend to approach unity throughout the rated capacity of the machine with, however, a slight drooping of the curve at extremely light and full loads.

The efficiency gradually increases with load with the curve between 75 and 125 per cent load quite flat.

Ordinarily the motor is practically a constant speed machine, although variable speed is obtainable by the insertion of a rheostat in series with the energy brushes or by an auto-transformer connected in the supply line to vary the applied voltage.

A further modification of the repulsion-induction motor is the repulsion-starting, induction-running machine, which has a single winding isolated from an armature similar in form and construction to the type used in direct-current motors. Brushes are provided and electrically interconnected by a metal supporting arm, the number employed being the same as in a given direct-current motor with a like number of pole pieces. Reaction of the stator currents upon the rotor winding induces rotation, and as soon as synchronous speed is reached, a centrifugally operated device short-circuits the commutator, thus providing essentially a machine of the squirrel-cage type.

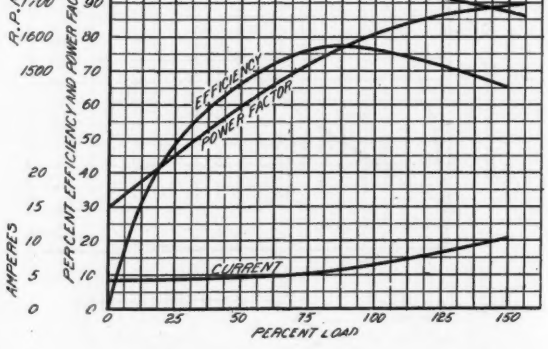


FIG. 144. CHARACTERISTICS OF A REPULSION START INDUCTION RUNNING MOTOR

The speed of this machine is practically constant, although the power factor is not nearly as satisfactory as that of the repulsion-induction motor. As shown in Fig. 144, its efficiency curve rises quite gradually from zero to about 80 per cent load, after which it declines in the manner indicated.

Motors of this type are well adapted to service similar to that for which the direct-current shunt-wound machine may be employed, and have the advantage of this machine in a considerably greater starting torque. It is not well suited for adjustable speed work.

Except for a laminated field structure, series-wound alternating-current motors are practically the same in construction as direct-current machines of the same type, and possess similar characteristics. They are primarily intended for light work, such as the driving of fans, blowers, drills, etc., although due to their powerful starting torque and adaptation of speed to load, they are utilized in traction and similar work to a limited extent.

The Care of Storage Batteries

WAYS AND MEANS BY WHICH LONG LIFE AND SATISFACTORY SERVICE MAY BE SECURED. BY JOHN BROOKE

THE CHARGING current of a storage battery should be applied as soon as the electrolyte is poured into the cells; otherwise the plates are liable to be injured by sulphating if allowed to stand in the acid without being charged. Never under any circumstances allow new plates to stand in the acid longer than 2 hr. before charge.

The first charge should be carried on for a period of from 20 to 30 hr. or even longer, as this charge is necessary to complete the formation of the plates. The charging may be carried on at the normal rate, provided the temperature of the cells does not go above 100 deg. F. If the temperature does go above this point, the charging current must be reduced.

Normal rate of charge is usually marked on the cell by the manufacturers, but it may be found by dividing the ampere-hour rating by eight. Thus for a cell, the rated capacity of which is 800 amp.-hr., the normal charging rate would be 100 amp.

The voltage required at the beginning of the charge will be about 2 v. per cell and this will rise to a maximum of about 2.7 v. when the cells are fully charged. As the charging nears completion, the cells will begin to gas freely, indicating that the plates have taken up nearly all the charge possible and that the surplus current is being used up in decomposing the electrolyte. At this point, it is well to decrease the charging current, although moderate gassing does no particular harm other than waste energy.

When the cells are first filled with electrolyte, the specific gravity will fall considerably below 1.200 due to absorption by the plates. The specific gravity will rise during the charge until it reaches 1.275 at full charge. During the ordinary operation of the cells the specific gravity is about 0.025 higher than when discharged.

General Charging

ALWAYS CHARGE at the normal rate or lower, except in case of emergencies. The longest life and highest efficiency is obtained when the battery is charged slowly. During the charge, the voltage rises from about 1.8 v. per cell to approximately 2.5 v. when fully charged.

As the battery becomes fully charged bubbles of gas will be given off freely, which will give the electrolyte the appearance of boiling. Sometimes these bubbles are so fine and numerous that they give the liquid a milky white appearance. When the battery reaches this stage it is considered fully charged, although it can be made to take up a small additional charge by reducing the strength of the charging current.

The specific gravity of the electrolyte gives another valuable indication of the amount of charge held in the cell, but it is the usual practice to depend principally on the voltmeter readings.

If the battery is allowed to remain idle for any length of time, it should be given a charge every week or two to compensate for the loss of charge due to current leakage. If the battery is allowed to stand much longer than two weeks without being freshly charged, there is great danger that the plates will be injured by sulphating.

Trouble is sometimes experienced from excessive acid spray. As the battery becomes nearly charged, the gas bubbles become so numerous that the electrolyte appears to boil and these bubbles breaking at the surface throw a fine spray of acid into the air. This spray corrodes all the metal fittings that it comes in contact with and is also very irritating to breathe.

Various remedies have been tried, such as having a film of oil over the electrolyte, which does away with the spray, but this is objectionable because it sticks to the plates when they are removed, increasing their resistance when they are replaced. Another plan is to place glass covers over the tops of the cells, but they soon collect dust which forms a conducting surface for the leakage of current. The best plan is to reduce the charging current near the end of the charge and depend on good ventilation to remove what fumes are given off.

Discharging

IN ORDINARY practice, a battery is discharged within a few hours after it has been charged. Under these conditions the battery will deliver from 75 to 80 per cent of the energy put in during charge.

If the battery is allowed to stand a week before discharge, there will be an additional loss of about 25 per cent in efficiency.

The discharge rate in amperes is usually the same as the charging rate, which is found by dividing the ampere-hour rating by eight. The battery may be discharged at a rate considerably greater than the 8-hr. rate for a correspondingly shorter time. In doing this, however, a certain percentage of the capacity in ampere-hours is wasted. For example, a cell, whose 8-hr. discharge rate is 50 amp. may be discharged at the rate of 200 amp. for one hour, but in doing this the cell suffers a loss of 50 per cent in its ampere-hour capacity. Excessive discharge rates are injurious to most forms of cells and should be avoided. A battery should never be discharged below a voltage of 1.8 v. per cell, except in the case of heavy discharge for short periods. If the battery is discharged at the one hour rate, the voltage may be allowed to fall as low as 1.6 v. per cell. If this rule is not observed the cell is likely to be permanently injured.

Never allow the battery to stand discharged for more than two or three days, as, otherwise, its capacity is likely to be considerably lessened by "sulphating."

Weekly Inspection

ONCE EACH week each cell in the battery should be carefully inspected and tested. With the battery fully charged, measure the voltage of each cell with a low-reading voltmeter.

With the battery fully charged also measure the specific gravity of the electrolyte in each cell by using a battery syringe to draw a sample for test. A low spe-

cific gravity or low voltage indicates trouble of some kind which should be investigated and corrected at once. If any of the positive plates have a light color it indicates insufficient charge. Examine the cells for short-circuits, both external and internal. When sufficient sediment collects in the bottom of the cells to threaten a short-circuit, siphon off the electrolyte, which may be used again, and flush out the cells with clean water.

The electrolyte should be kept at least ½ in. above the tops of plates. Any electrolyte that is spilled or dissipated by acid spray should be replaced by electrolyte of 1.200 specific gravity. Any loss due to evaporation must be replaced by distilled water. If the hydrometer shows a lower figure when the voltage of the cell and the color of the positive plates indicate full charge diluted acid should be added to bring up the specific gravity to 1.200. Never add strong acid directly to the electrolyte in the cell. If the specific gravity is too high add pure distilled water to the bottom of the cell with a battery syringe or a rubber tube. It is necessary to add the water at the bottom, as it is lighter than the electrolyte and if added at the top it would not mix well. A record should be kept of the weekly inspection of the battery so that a comparison can be made from week to week of the action of each individual cell.

Short-Circuiting

A SHORT CIRCUIT is indicated when the voltage and the specific gravity are below normal. The short circuit may be caused by sediment collecting in the bottom of the cell or by some foreign substance falling into the cell. Cracked insulation may also cause a partial short circuit. A cell that has been short-circuited will require more than its usual amount of charge for some time.

Sulphating

A CELL is said to be sulphated when a whitish scale of lead sulphate forms on the plates. This scale is a nonconductor and thus serves to insulate the active material from the plates. Any indications of sulphating should be corrected at once, for if it is allowed to continue, it not only will greatly reduce the capacity of the battery but will also lead to other serious troubles. Sulphating may be caused by allowing the electrolyte to get too hot (due to an excessive discharge rate). The plates are also likely to sulphate if the electrolyte is too strong. A short circuit may also cause sulphating by discharging the cell below its proper voltage.

A cell that is badly sulphated should have the elements removed and carefully scraped and worked until all traces of the scale have been removed. The cell should then be charged at a low rate (from one-quarter to one-half the normal rate) and only partially discharged. This treatment should be continued until the sulphating is entirely eliminated and the cell returns to its normal condition.

Flaking, Disintegrating and Buckling of Plates

IF THE plates are allowed to become badly sulphated the final result will be that the active material will peel off in large flakes. Buckling is caused by sulphate working in between the active material and the supporting grid. Flaking and buckling are also caused by excessive discharge rates and sometimes by long continued overcharge.

Flaking reduces the capacity of the cell, due to loss of active material. Buckling is likely to break up the pellets of active material and cause them to drop out. Positive plates are more likely to receive injury than negative plates and it is to them that particular attention should be given.

Taking the Battery Out of Service

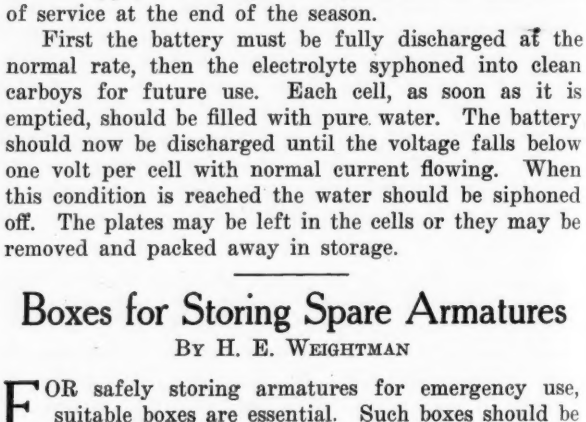
IN MANY installations, such as country residences, summer hotels, etc., the storage battery is allowed to lie idle for a period of several months. In installations of this type, the storage battery should be taken out of service at the end of the season.

First the battery must be fully discharged at the normal rate, then the electrolyte syphoned into clean carboys for future use. Each cell, as soon as it is emptied, should be filled with pure water. The battery should now be discharged until the voltage falls below one volt per cell with normal current flowing. When this condition is reached the water should be siphoned off. The plates may be left in the cells or they may be removed and packed away in storage.

Boxes for Storing Spare Armatures

By H. E. Weightman

FOR safely storing armatures for emergency use, suitable boxes are essential. Such boxes should be waterproof, easy to move and designed to occupy a minimum space. The details for constructing boxes of different sizes which will fulfill these requirements are


TOP OF BOX
ARMATURE
WOOD SCREWS
MUST BE 5" OR MORE
M. SCREW F. ¾" LONG WITH WASHER
BRACE BLOCK TWO REQD.
BOTTOM OF BOX
TRIM TO
GLUE BOARDS TOGETHER GRAINS CROSSED & FASTEN WITH WOOD DOWEL PINS. DRILL HOLE AND CUT ON HEAVY LINE.
M. SCREW SOCKETS OR ANCHORS TO TAKE ½" SCREW
DETAIL OF END
WOOD SCREWS
WOOD SCREWS

DETAILS FROM WHICH BOXES OF DIFFERENT SIZES CAN BE MADE FOR STORING ARMATURES

given in the accompanying drawing. The framework is made of white pine, the inside is lined with tar paper and the outside is painted. The box is provided with castors as shown.—Electrical Record.

EVEDENCE OF unusual activity in the promotion of foreign trade is found in a survey of the foreign trade activities of chambers of commerce just completed by the Foreign Trade Department of the Chamber of Commerce of the United States. In many cases, it was found that chambers of commerce in inland cities are displaying as much interest in matters of foreign trade as cities along the seaboard.

Some Lubricating Troubles

FAILURES OF GREASE CUPS AND HOW THEY WERE REMEDIED. BY H. A. JAHNKE

IN SOME manufacturing plants, very little attention is given to the proper lubrication of machines and line shaft bearings. In many instances, we find the grease or oil cups in such condition that they are worse than useless for lubricating the apparatus to which they are attached. This practice not only wastes power, but also wears out the pulley shaft bearing or whatever the lubricating device is supposed to serve.

To show how true this is, I may relate a few instances. At one time, I was called to repair a large loose pulley on a machine which had run hot and seized the shaft. When I had the pulley in running condition again I examined the oiling device which consisted of a large common grease cup at the end of the shaft and the grease was forced through a hole in the shaft into the pulley as shown in Fig. 1. The cap on the cup was turned down to its limit, and by appearance it seemed as if it had not been refilled for a long time. .I found it was impossible to turn the cap back due to the fact that at some time the cap had been hit placing a dint at the end as shown in Fig. 2 at a. The cup was needed badly, as there was none in stock of this type and size to take its place. For this reason, I did not want to ruin the cup entirely by turning the cap back in the condition it was; so I sawed off that part of the cap with a hack saw as shown in Fig. 3. This made it possible to turn the cap back without ruining the threads, on any part of the cup. Then, with a file, the cap was finished off where the hack saw had left rough edges. In this way, it was possible to make further use of the cup, saving the price of a new one, also avoiding a larger shut-down of the machine.

AUTOMATIC GREASE CUP TROUBLE

FREQUENTLY a grease cup of an automatic type will not feed when the cup is about half empty, making it necessary to refill it. This at times is caused by the cap not being screwed straight onto the cup body; then, when about half empty, it will not feed due to the fact that the piston or plunger binds in the cup as shown in Fig. 4, which is exaggerated to make the matter more plain.

ENLARGEMENT OF HOLE IN CUP CURED THE TROUBLE

IN ANOTHER instance, a heavy grease was bought to use in all the grease cups in the plant, in the common as well as automatic grease cups, with the result that the small automatic cups would not feed until the bearings were quite hot so as to soften the grease when they would feed a little. A number of bearings were ruined by the use of this grease in a short time, as there was a large amount of it on hand and the owners of the plant were anxious to make use of the grease. I got out of the difficulty by enlarging the hole in the cup body where the grease feeds through on to the shaft, as shown in Fig. 5, at a. After this, there was no further trouble with the cups not feeding.

No doubt, somebody will say, "Why was not a lighter grease bought to use in the small grease cups?" This the management would not do on account of the large amount of grease on hand, and the method I used to get out of the difficulty did not ruin the cups.

WHY AUTOMATIC CUPS FAIL TO FEED AT TIMES

FREQUENTLY grease cups of the automatic type fail to feed properly no matter whether the adjusting screw in the cup is wide open or not. This trouble is usually due to the fact that the grease in the cup gets hard and is especially true where the cups are adjusted so they feed very slowly in such places as on loose pulleys, shaft bearings, etc., where the cup does not feed when the pulley or shaft is idle, frequently for days. It is during this time that the grease gets hard as the pressure from the plunger or piston on the grease in the cup forces that part in the grease which keeps this in a soft condition out of the grease while the hard matter remains in the cup and will not feed through the small hole in the cup when the pulley or shaft is in operation again.

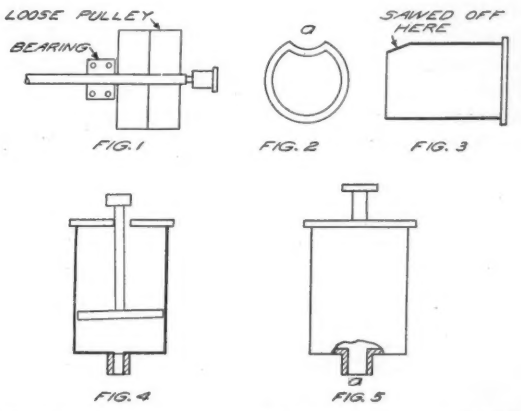


FIG. 1. LOOSE PULLEY WITH GREASE CUP ON END OF SHAFT
FIG. 2. END OF CUP WITH DINT ON SIDE
FIG. 3. GREASE CUP WITH DINTED EDGE SAWED OFF
FIG. 4. AUTOMATIC FEED CUP WITH THE PLUNGER BOUND
FIG. 5. CUP WITH ENLARGED OUTLET

I have also seen instances where automatic grease cups are not allowed to run empty entirely but new grease is added each day to that which still is in the cup so as to keep the cup nearly always full. When, in course of time, the old grease in the bottom of the cup gets hard, the cup will not feed with the adjusting screw wide open and the machine operator or oiler is wondering why the bearings run dry. Before the cup will feed again, this hard grease must be removed and cup refilled with new grease.

I am aware that not all makes of grease cause this trouble, but I also know there is some on the market that will and wherever possible this should not be used in grease cups of the automatic type if you want to avoid trouble.

CAUSE OF ECCENTRIC HEATING

IN ANOTHER instance, the eccentric on a high-speed steam engine would get quite warm near shutting down

time at night. This eccentric was lubricated by means of an automatic grease cup. It took me a long time to find the cause of this trouble. It was caused in the following way, which was very simple after it was found. The grease cup was refilled each morning before starting, and was just about of a capacity and adjusted so that the grease in it would last all day.

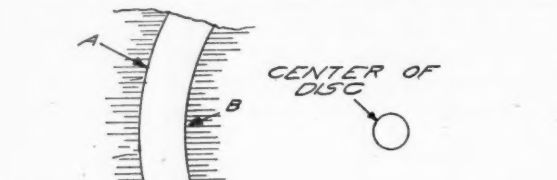
A few days before I noticed that the eccentric was getting quite hot near shutting down time, that the cup was not quite as empty as before, but paid no attention to this until I noticed that the eccentric was heating; then I examined the eccentric and grease cup and found that the cup was the cause of the trouble, as when the plunger or piston in the cup came to a certain point in the cup near the bottom, it failed to feed. This trouble was remedied by placing a new spring in the cup as the old spring got too weak from long use to feed properly when the piston got near the bottom. I could, perhaps, have remedied the trouble by adjusting the hole in the cup a little larger; but in that case, the cup would have fed too fast at the beginning after it was refilled and the grease in it would not have lasted all day.

Rotary Engine Fallacies

A Typical Case. By N. G. Near

EVERY natural born mechanic, at some time or other, finds that it behooves him to do some original thinking along the line of rotary engines. He gets the incentive shortly after he has been convinced that perpetual motion and friction are poor partners. A new rotary engine has recently been brought to my attention so forcibly and it is so typical of others that have come to my observation that I cannot resist writing about it.

Photographs were sent to me by a friend of mine, who is also a friend of the inventor, with the query, "What do you think of it?" The pictures were so small that I could not make out the detailed construction; but I wrote my views on rotary engines in general to my



VALVE OF ROTARY ENGINE AND GROOVE IN WHICH IT RUNS

friend, stating that my faith in them is small. The mechanical difficulties are very serious; the steam turbine is more efficient than any rotary engine will ever be; the reciprocating engine is efficient in spite of its reciprocating parts and its flywheel; there is very little demand for a rotary engine and even if one could be built that would operate with as high efficiency as the reciprocating engine or steam turbine it would first have to prove itself dependable, long lived, quiet, and not much higher in first cost and maintenance than the competing types. The future for the rotary engine even if it could be successfully built, does not seem particularly bright.

Nevertheless, in spite of my objections my friend persisted in bringing up the subject at every opportunity. He said, "You would change your mind if you would take a look at it. This engine is different. It is destined to replace both the turbine and the reciprocating engine. I'll take you over to the factory in my car and show it to you."

My friend wired the inventor and we went over. We found the machine shop labeled with a large sign "The ——— Rotary Engine Company," and I expected everything would be in ship shape for a test. But, no such thing. The parts were lying all over the work bench. A hole was being tapped. Steam was being raised in an old threshing engine boiler outside the shop.

The inventor made excuses, talked about a new model, hard luck in machining first model caused leaky joints, valves made too much noise. He was perfectly frank in admitting that his first model was not perfection but his new model, as yet unfinished, would be the acme of perfection. The corporation is selling stock, and thus far it has been fortunate in disposing of several thousand dollars worth. The inventor has a model actually built, which will actually run and develop power, hence it is no fake. Those who buy stock become members of a "going" concern.

The principles of the rotary engine were explained to me in a loud voice so that the several prospective stock buyers in the shop could get the benefit. Criticism at this time was of course unwelcome.

This rotary engine proved to be built along lines that came to my mind many years ago. Steam is admitted into a curved groove of rectangular cross section which is concentric with the shaft. A piston in this groove is pushed in one direction by the steam which is admitted regularly with each revolution of the piston. Every time the piston passes the admission port a hinged valve flops into the groove and forms a back stop for confining the steam. This valve says, "click, click, click," with every revolution and its talk becomes more boisterous in direct proportion to the speed of the engine.

By this time, the parts had been assembled and steam was turned on. The engine "leaked like a sieve" as my friend truthfully expressed it, enveloping the engine so completely in a cloud of steam that it could scarcely be seen or touched.

"Here, take this waste and try to stop the engine," the inventor commanded. Dutifully I took the waste and pressed it against the smooth flywheel. It diminished its speed, but did not stop it. I could have stopped it easily, but what sort of a test is that? Besides, the inventor seemed pleased that I did not stop it.

The boiler pressure registered 120 lb. The speed of the engine varied all the way from 100 to probably 1000 r.p.m.

After the demonstration, if such it may be called, my friend called me to one side and said, "Now, what do you think of it?"

It was necessary for me to admit of course that my viewpoint had not improved. I was still unconvinced. Simply to run is not enough. To compete successfully with other prime movers, a rotary engine must show equal or better steam economy, or, it must find a field into which it fits better than any other prime mover and where it will be used in spite of its poor steam economy.

Our mutual friend called the inventor and led me into the small office adjacent to the shop and suggested that we talk it over. He stated that it was his understanding that the inventor was "looking for" criticisms. He said to me, "Now, just what do you claim is wrong with this rotary engine?"

For an hour or more, I raised arguments against his engine and he answered them to his own satisfaction, but not to mine. A few of these points will suffice to show his lack of appreciation of the mechanical difficulties which he must encounter.

I said that he would never be able to make his steam engine as tight as a reciprocating engine because of his rectangular piston and the flat rubbing surfaces that cannot be packed as perfectly as in the round cylinder.

He replied, "It is not difficult to machine the parts on my engine to a steam tight fit. Besides, a film of oil gets in between the flat surfaces, eliminates friction and prevents leakage. The machining problem is not a difficult problem."

"It will be impossible for you to make a hinge valve that will swing into the circular groove and still be steam tight. It is a mechanical impossibility because circle A is concave with respect to the valve, and circle B is convex with respect to the valve. The only kind of valve that will fit in such a case is one that slides in at right angles. It must move in a perfectly straight line and not in a curved line."

"Your argument is correct, but the leakage isn't great."

"You have made no provision for wear."

"There will be very little wear on account of film lubrication; but even if there is wear, I can take care of that by tightening up against the gasket in the casing joint."

"You cannot vary the cutoff in your engine."

"That is true, but I can take care of that by using a throttling governor."

"Your piston area is small as compared with its great travel, which is equivalent to using a small diameter piston in a reciprocating engine with long stroke. This gives you small power and great friction surface."

"The oil in my engine reduces the friction to almost nothing. In reciprocating engines, they use piston rings on the pistons, which makes them so tight that you can hardly move them by hand."

He called my attention to the great leakage in steam turbines claiming that they are "nearly all leakage." "Yet," he said, "we all know that in spite of the leakage the steam turbines are pretty efficient. In my engine where I cut out nearly all leakage and still have a rotary motion, it is easy to see why I won't use nearly as much steam as in the steam turbine."

The inventor dwelt to some considerable extent upon the power lost in starting and stopping the piston in reciprocating engines and broke into an oration against flywheels.

I have not gone into the why and wherefore of all points covered because most readers doubtless already understand them. This is what I consider a typical case of trying to do something without laying the proper foundation of education, investigation and experience.

Engine Room Telephone Signal

By L. J. Goodrich

FREQUENTLY we have telephones located in noisy places and even in sound-proof booths, connected with loud ringing twin gongs located at convenient places. The sounds emitted by the best of gongs do not carry any great distance, especially in noisy mills, factories and engine room.

The writer has used the following apparatus with extremely good success. Replace the gong with an automobile horn. The type of horn depends upon the class of current used. With a 24 hr. electric service, a.c. voltage can be reduced by a bell ringing or multi-tap toy transformer or a suitable resistance of the Ward-Leonard unit type for d.c. There are various types of ringing attachments to be had from electric supply houses, the type of circuit closing device depends upon whether you wish a constant ring non-code call or whether you require a circuit closing attachment that will function to the various code rings. A motor driven horn should be used on d.c. circuits of 6-8 v. and the vibrating type used on a.c. circuits of 12 to 20 v. Any good multi-tap 110-125/6-22 v. toy transformer will serve the purpose. All additional horns should be connected in multiple in the circuit.

When dry cells are to be used for current supply, six cells should be connected for 6 v. series multiple. An ordinary low resistance pony telegraph relay with the coil windings changed to a biased connection, thereby causing the armature not to vibrate at each pulsation, makes an ideal circuit closing attachment where code ringing is desired. If heavy currents are used in the ringing circuits, excessive sparking may appear at the contact points. This can be overcome by placing a shunt circuit across the line a condenser made of alternate laminations of tin foil and well shellaced empire cloth or fibre dielectric. About 10 sheets of 6 by 8 in. tinfoil, alternate sheets bound together and placed between two boards with the brass screws and nuts taken from the carbon pole of a dry cell. A relay, horn and transformer with other incidentals can be bought for about $15, which is near the price of a good twin gong and sounds far more penetrating in noisy places.

During the eight years from 1911 to 1919 the amount of waste produced by the collieries of South Africa was reduced from 30 to 16 per cent of the total coal mined. Recent statistics show that the waste now amounts to about one million tons annually.—Compressed Air Magazine.

Shutting Down the Ice Plant

PRECAUTIONS TO BE TAKEN AND PROCEDURES TO BE FOLLOWED IN PREPARATION FOR THE IDLE SEASON. BY A. G. SOLOMON

EVERY YEAR many thousands of dollars are actually thrown on the scrap pile of neglect. This monument of waste is found around the ice plants in all parts of the country. Carelessness and lack of foresight on the part of the engineers are the cause. Replacement of bursted valves, fittings, pipe, pump and engine cylinders and other ice plant equipment which was allowed to freeze, represents the greater part of this tremendous loss.

Steam, ammonia and water leakage, caused by pitted cylinders, piston rods and valve stems, is another costly result of neglect in the shutting down of the plant at the end of the season.

Conservation of material means more now than ever before. The cost of all material has doubled and trebled during the last few years. And cost is not the only consideration; material of all kinds is hard to get at any price.

CARE OF PIPES AND FITTINGS

DURING THE next month or two a great many ice plants will be closing down for the winter.

The larger plants and those that are connected with cold storage will continue to operate at reduced capacity and the overhauling work will be done during this period. But there are many ice plants that will be entirely shut down and closed up. As a rule, but one man is kept during the winter and it becomes his duty to see that the plant is in good condition for the next season.

There are two causes of delay and expense that must be guarded against, the first and most common of the two being bursted pipe, fittings, valves and other equipment due to freezing. The other cause is corroded, pitted and rusted parts of machinery owing to lack of attention at the time of shutting down.

Too much care cannot be exercised in the draining out of the different parts of the plant. The boilers must be emptied and cleaned thoroughly and left ready for steaming up when warm weather comes again.

First see that the building is in proper condition to protect the machinery. The roof must not leak and the walls must be tight so that snow and rain does not enter. The doors and windows must be in such condition that the place can be locked up; sneak thieves and tramps often cause a lot of damage.

Lubricators, oil cups and other brass fittings will disappear from a plant that is not securely locked up.

All brasses, lubricators and gages should be cleaned and packed away in a safe place. If there are a number of such articles, each should be marked as to where it belongs. This will make easy the replacing.

THE AMMONIA SYSTEM

BEFORE THE plant is shut down it is best to decide on where the ammonia is to be stored.

There are two parts of the system where the charge can be placed; one being the ammonia condenser and the other the ice tank. The amount and nature of the work to be done on the ammonia system will act as a guide as to where the ammonia is to be stored. If the ice tank is to be overhauled, the charge must be put in the condenser; or if the condenser is to be rebuilt or repaired, the ammonia must go in the coils of the ice tank. If the whole system is to receive a complete overhauling, it is best to draw the ammonia out into drums and store it in some cool place where it will be out of the way and not have to be moved.

Look over the condenser and see what work is to be done; if this work can be accomplished in a short time, it is a good plan to get busy and get the condenser in shape the very first thing. Then pump all the ammonia into the condenser and leave it there. This is the most simple and easy way of disposing of the ammonia and it should be done if possible. Don't forget to look over the condenser for leaks, as leaks may develop even while the plant is shut down.

If the condenser is of the atmospheric type, the coils should be cleaned and all scale and dirt removed. A coat of graphite and oil will be found a good preservative and will prevent rusting of bolts and pitting of pipe work.

Give extra attention to the ammonia headers and such places where water splashes. Pipe work that is subjected to alternate wetting and drying will soon become pitted so that small pinholes will develop. Cover such places to protect them from the splashing or at least give them an extra heavy coating of water-proof paint.

The double-pipe type of condenser must receive extra attention. Do not take chances on draining. Disconnect the water lines leading to and from the condenser and also remove every one of the water return bends. It is common practice simply to loosen a few of the water return bends and take it for granted that all the water will drain out. Some of the bends may be choked or there can easily be some obstruction in one of the inner

tubes. To be perfectly sure that drainage is complete and also to have the condenser ready for next season, take off all the return bends and scrape the inner tubes with a stiff wire brush which is fastened to a length of ½-in. pipe and used just like a tube scraper for the removal of soot in boiler tubes.

During the winter, test the open ends of the inner tubes for ammonia leakage. A small amount of powdered sulphur burned in a ladle will be found to be a good substitute for sulphur sticks.

The open ends of the tubes must be protected to prevent rusting and pitting which will result from snow and rain.

Before leaving the ammonia condensers, all the ammonia valves must receive attention. Leaking valves should have been noted during the summer and now that the plant is shut down, such defects should be repaired.

If there is the slightest doubt about the tightness of the valves on the ammonia lines leading to and from the condenser, the lines should be disconnected and blind flanges put on next to the valves. This will insure against possible loss of ammonia.

The Ice Tank

Next to receive the engineer's attention is the ice tank. Do not empty the brine out of the tank unless it is necessary. As a rule, an ice tank should be emptied only about once in 5 yr. Save the brine if possible, for the making of new brine is costly. The amount of salt used for the making of brine is figured at just about three-fourths of a ton to each ton ice making capacity of the tank. The brine can be pumped into the ice cans and poured back in the tank after the tank has been overhauled. In putting the brine back, strain it through a strainer made of two or three thicknesses of burlap nailed across a part of the tank top.

If the tank is emptied, it should be cleaned out right away and the coils scraped, brushed and painted with graphite and boiled linseed oil. If this is not done, leaks are liable to occur as the drying brine will cause deep pitting in the pipe.

If the tank is to be overhauled, the steaming out of the coils had better be done as soon as possible after the plant is shut down. This will be all that the boilers will be used for during the shut-down period, so after it is done the boilers can be laid up.

If the ice tank is not to receive an overhauling, it must be left in condition so as to be ready for freezing at the beginning of the season. Much depends on the part of the country in which the plant is located. If the location is in the far north and the weather gets cold enough to freeze the water in the cans, the cans will have to be left empty. This freezing would require extremely cold weather of long duration. If this precaution is necessary, the empty cans must be weighted down in the tank so as to keep the coils submerged. A few bricks in each can will do nicely.

If there is no danger of freezing, the cans are filled with distilled water and left ready for freezing down at the beginning of the season. Cover the tank as much as possible to keep dirt out of the water.

Distilled Water System

Most types of steam condensers will drain out clean and there is no danger of freezing.

Double-pipe steam condensers are often neglected owing to the trouble and labor required to drain them properly. The best way to lay up this style of condenser is to take off all of the water return bends and then remove the inner tubes. This is not as hard a job as it looks, for the outer surface of the tubes is coated with cylinder oil from the exhaust steam and they will slip out through the packing easily. By allowing the inner tubes to lie outside during the winter, the accumulation of scale on the inner surface will become loosened and can be readily removed.

Steam condensers of the shell and tube type should have the bottom manhead removed and the space below the tubes cleaned out.

Reboilers and Flat Coils

The reboiler is drained by simply opening the drain valve in the bottom; but the steam coil must not be neglected or it will burst. If there is no other way to drain the coil, it must be lifted out entirely and placed upside down so that the water will drain out through the inlet and outlet openings.

Flat coils are hard to drain no matter how they are built. Most engineers are satisfied to blow them out with steam and call it a good job. This may be all right, but it does not take much time or labor to disconnect the coil and by raising first one end and then the other, the complete drainage would be sure. To do this, a block is placed under the middle of the coil so that the ends swing clear of the pan. Then with one man at each end rock the coil slowly up and down till no more water comes out at the bottom opening.

The double-pipe coils must be treated the same as the double-pipe steam condenser.

The Pipe Work

To lay up an ice plant properly for the winter months, a lot of steam, exhaust and water lines must be disconnected. Few plants are provided with drain valves in all the places where they are needed. If any part of the piping cannot be drained in any other way, take it apart; and when the connections are made at the beginning of the season, be sure to provide suitable drains. Use graphite and oil on all pipe joints and they will come apart when disconnecting is again necessary.

Do not allow water to remain in such places as between the gates or wedges of gate valves, or in the body of globe angle and check valves.

When a gate valve is closed in a line containing water, the space between the two seats of the valve will remain filled. If the valve is in good condition and not leaking, the line can be drained both sides of the valve and still the valve will burst when freezing weather comes.

Engines and Pumps

All engines and pumps of all kinds need a thorough examination at least once a year. In an ice plant the winter months is the time for this inspection.

The visible parts of machinery are easily looked after and for this reason their condition is known at all times. But exactly what is going on inside the cylinders

of engines, pumps and compressors can only be known by looking into them.

So when the plant is shut down at the end of the season it must be remembered that this internal inspection is to be made.

We all know what the results are when a machine is allowed to stand in one position for a length of time without removing the piston rod and valve stem packing. At the point where the packing is in contact with the rod we find that the rod is pitted and rough. The moisture in the packing is the cause of this.

To avoid the expense of having otherwise good rods turned down the packing should be taken out of every stuffing box on every piston rod and valve stem in the plant.

Next the cylinder heads should be taken off and the pistons removed. Examine the cylinders and pistons and if everything is in proper condition give the cylinder walls a coating of cylinder oil and graphite and replace the piston. The steam and exhaust valves are also taken out and examined for defects.

The core plugs that are found in most pistons and Corliss valves should receive attention. Often a core plug is not tight and during the time that the engine has been running the hollow of the casting becomes filled with water. In cold weather this water will freeze and a cracked piston or valve is the result.

The water jackets of ammonia and air compressors must be really cleaned. This does not mean the simple opening of the drain valves. There is no water that does not deposit some scale, sand or other sediment in the passages of the water jackets. The moisture contained in such sediment, packed in a small pocket of the casting will cause bursting of the jacket when frozen. Cases of this kind are not common but they do happen.

There is one other point that must be watched for freezing. That is the water end of pumps. Water cylinders are usually provided with small pet cocks or drain plugs. The opening in the pet cocks is nearly always blocked up and the plugs are about impossible to remove.

The only safe way to drain the water end of a pump is to take off the heads and remove the pistons. Even then the chamber above the discharge valves will not drain. One of the discharge valves must be taken out or raised up to allow the water to drain out.

To sum up. Look over everything in the plant and do not take any chance on freezing and bursting. And do not allow rusting, pitting and corrosion of any of the equipment even if it does require some labor to prevent it.

Some Refrigeration Plant Operation Hints

PUMPING-OUT AMMONIA COILS; REMOVING OIL AND BRINE. BY W. A. DARTER

SOMETIMES, in case of ammonia leaks, it becomes necessary to pump out a set of evaporating ammonia coils quickly in order to save ammonia and time. To lose ammonia at the present time is akin to a catastrophe. At other times, in order to make changes and repairs, an engineer wishes to lose as little time as possible in pumping down coils and tanks. Hence methods used by this refrigerating plant may be of benefit to others.

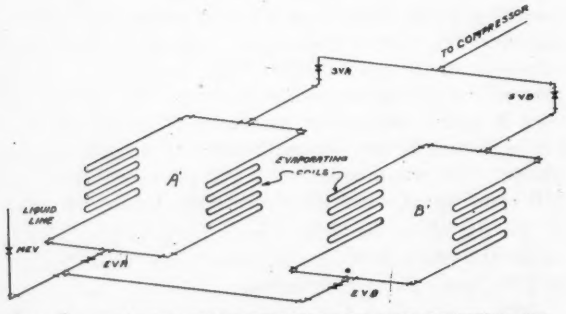


FIG. 1. SHOWING CONNECTIONS FOR THE REMOVAL OF AMMONIA

Sometime ago a gasket blew out near the expansion valve of a set of flooded evaporation coils, and it was necessary to pump the coils quickly or loose not only the ammonia, but a great deal of stored meats. It so happened that the coils were flooded more than usual that morning which made conditions worse. Also, the coils were covered with a thick coating of ice and the evaporation of the liquid would naturally be slow; and to have pumped them down by the general method would probably have taken several hours.

One way whereby the ammonia can be saved, is to pump a partial vacuum on the coils. This method, if the pressure in the coils is taken below atmospheric, will draw in air through the leak into the system and still be a time losing process. If this method is used, the pressure on the coils should be kept as near atmospheric as possible and when a good size compressor is used, it is necessary to run it slow or regulate the suction to the coil by the suction valve. If only one compressor is in use, it can be run at its normal speed by supplying just enough gas from other rooms to keep the pressure in the disabled coils just below that of the atmosphere.

The quickest method to pump out the leaking coils, is to take the ammonia liquid out of the evaporating coils through the expansion valve as shown in Fig. 1. Let A′ and B′ represent coils in rooms A and B; and assume coils in room A leaking at the top ell. Then to take the liquid back through the expansion valve of room A, close master expansion valve marked M. E. V., and suction valve to room A marked S. V. A., then pull a partial vacuum on room B with expansion valves to both rooms wide open. This partial vacuum on coil B, and the gas pressure produced by the liquid in coil A evaporating, will force all the liquid out of coil A in a very few minutes. After all the liquid has been drawn out of coil A and a vacuum pumped on coal A, close the valves valves to room A, and the rest of the refrigeration system can be put back into normal operation.

This quick method can be used in any system that

has a master expansion valve and a suction valve to each set of evaporating coils.

Detecting Ammonia-Free Coil

We have all heard of the engineer who "thought," that the specified coils had been pumped to a vacuum or atmospheric pressure; and upon opening them there happened to be ammonia, yes, plenty of ammonia under pressure. We all know of accidents and cases where many pounds of ammonia have been lost just because the engineer did not know the condition of the coils upon which he was working.

This simple information should be clearly understood by every refrigeration engineer, yet strange to say the average engineer will be misled. A safe method to follow is never to open a pipe system or part of a system that shows signs of active freezing or frosting on the outside of the pipes, and, unless the gage shows at least atmospheric pressure or less. If a pipe system shows frost on any part at atmospheric pressure, this is absolute proof that there is liquid ammonia in the system and that this liquid ammonia is gradually evaporating. Sometimes a set of coils all covered with ice in a cold room can be pumped down until the pressure shows no signs of rising and an engineer may think all the liquid is out; but the liquid may be lying in the pipe unable to absorb heat that it may boil and evaporate. The liquid ammonia must take in heat or else it cannot boil, and if the pipes are covered with ice the absorption of heat is slow, and hence the evaporation also.

Sometimes it is necessary to repair leaks or change valves in small one-door-rooms where ventilation is impossible; and it is not always safe to break into the system unless a continuous suction can be kept on the coils.

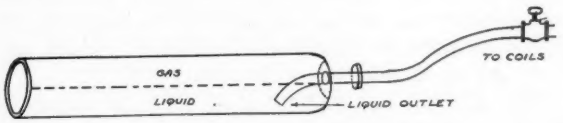


FIG. 2. TO REMOVE AMMONIA FROM DRUM PROVIDE MEANS WHEREBY THE GAS IS KEPT AT THE OUTLET LEVEL

At a certain plant it became necessary to change all expansion valves to the cold storage rooms. It developed that practically every suction valve leaked to some extent, and it was impossible for the repair man to change the valves, unless a continuous small amount of suction could be kept on the coils. To do this and still lose as little refrigeration as possible, the compressor was run at normal speed, and enough gas was taken from the other rooms to keep the suction pressure at atmospheric. It is important that the engineer keep out of the system all the air possible, hence the coils must have atmospheric pressure.

Similar to pumping coils down is charging a system with drums of ammonia. It is economical to drain each drum thoroughly of all its ammonia; and to be sure that all the ammonia is out, the same principle can be applied. To empty a drum of ammonia is the same as pumping down the drum. Connect the drum to the system in such a way that the gas will be above the outlet of the drum as shown in Fig. 2. Then close any liquid valves emptying into the same evaporating coils, and pump down the system to at least atmospheric pressure. The liquid evaporating in the upper half of the drum produces a pressure which will drive out the liquid. When the liquid is all forced out except the small amount below the end of the opening, the drum will begin to sweat and probably frost under the bottom due to this small amount of liquid evaporating in the drum. Keep pumping on the drum until all signs of frosting are gone, then the drum can be disconnected and weighed again to be sure that all the liquid is out.

If the drum begins to frost some distance up its sides, this indicates that the drum is not in the right position, or else the drain pipe on the inside is broken off. It is not likely that this pipe is broken.

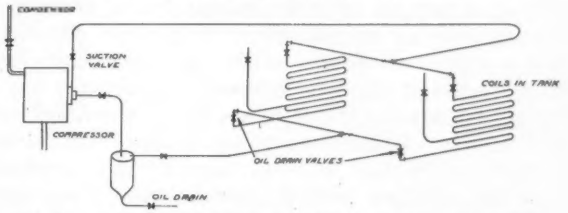


FIG. 3. CONNECTIONS FOR REMOVAL OF OIL AND BRINE

Before any ammonia system is broken this question should be answered: "Does that coil or tank contain any liquid ammonia?" It is not enough to know that the coil has a vacuum on it, for it may have a vacuum on it and still have liquid in it.

Freeing Coils of Oil and Brine

Some operators (not engineers) believe when they pump down an evaporating coil they pull over the oil and brine with the gas ammonia.

A case similar to this happened a few weeks ago in a small plant. This plant was not producing the ice it should, and an engineer was called in to see what the trouble could be. The engineer, upon entering the small plant, noticed the operator draining the oil trap on the discharge side of the ammonia compressor, and he asked the operator how much oil they took from the trap daily. The answer was about 5 gal. The engineer then asked the chief if the coils in the freezing tank were free from oil. The chief told him that he was sure they were, for he pumped the coils down to zero pressure every week.

The freezing tank coils were provided with two oil drains as shown in Fig. 3, but the chief did not know how to get the oil out of the coils. To rid these coils of oil, two methods may be applied. One method is to close the suction valves to the two coils and open up the valves in the drain lines. The liquid evaporating in these coils will produce pressure and drive the oil and brine over into the oil accumulator or trap, and the trap can then be drained. The other method is to open both valves in the drain lines and the valve between the compressor and trap. Then choke the compressor suction valve and produce less pressure in the oil accumulator than there is in the coils. This difference in pressure can be made great enough to force the oil and brine over into the oil accumulator. After the tank was freed of most of its oil, the tank production increased.

Chemists Discuss Fuels

NOTES OF INTEREST TO ENGINEERS GATHERED AT FUEL SYMPOSIUM OF THE AMERICAN CHEMICAL SOCIETY

A NEW FUEL, which is smokeless and which is manufactured from bituminous coal was described by Dr. Harry A. Curtis at the meeting of the American Chemical Society held at Chicago, Sept. 6 to 10.

Carbocoal, as it is called, is a bituminous coal which has been transformed into a smokeless fuel resembling anthracite. It is prepared by crushing the soft coal and carbonizing it at a relatively low temperature of 900 deg. F. This primary carbonization of the coal is carried out in a horizontal retort about 7 ft. in diameter and about 20 ft. in length, lined with carborundum. During the process of carbonization, the coal is continually stirred and moved slowly through the retort by means of paddles mounted on two heavy steel shafts running lengthwise through the retort. Each retort has a capacity of about a ton an hour—the process being continuous. Low temperature carbonization of coal in this manner yields about twice as much tar as is obtained from the ordinary coking process, but the semi-coke obtained is quite soft and pliable. It can be used directly under the boilers of a power plant as fuel or put into a gas producer, but in the form discharged from the retorts is not in good shape to market as a general fuel for domestic and industrial use.

In the "Carbocoal Process," the soft semi-coke is ground, briquetted with pitch, and the briquets then carbonized for about 6 hr. at 1800 deg. F. The effect of this high temperature carbonization is to render the briquets hard, dense and smokeless—quite unlike any other fuel on the market. A further substantial yield of by-products is obtained during the second carbonization, so that the process represents a very economical method of producing a smokeless fuel from bituminous coal. The briquets being in the form of small spheres, the fuel is very easily handled and suitable for transportation. The high yield of oils obtained is also of great importance in view of the enormous growth of industries which use oil products such as gasoline, motor spirits, lubricating oils and fuel oil.

The first commercial plant manufacturing the new fuel was put into operation at Clinchfield, Va., in June, 1920, and is equipped with 24 retorts giving a capacity of 500 tons of coal a day, from which 350 tons of the fuel are made. After 5 yr. of experimental work at Irvington, N. J., this large scale commercial plant at Clinchfield was established as a Government war project.

The plant, however, is equally desirable in peace times, for the process employed is one step towards the solution of the large problem of the more economic use of our greatest natural resource—bituminous coal.

ADVOCATES ENRICHING ILLUMINATING WATER GAS WITH NATURAL GAS

DR. GARVER, a Pittsburgh research chemist, presented a paper in which he advocated the enrichment of illuminating water gas with natural gas, as a means of economy.

Natural gas companies, he said, are selling their output at ridiculously low rates. Instead, they should utilize it for the benefit of the greatest number by combining it with artificial gas. In this way, this natural resource could be so used as to insure to the public for many years to come a supply of gas at a cost at which it would otherwise be impossible to sell it.

Blue water gas, although lower in heating value than coke oven or coal gas, can be made most economically. Blue water gas carburetted by means of gas oil cannot, however, under present market conditions on crude petroleum be the kind of commercial gas for an adequate public supply. In addition, this use of the waning supply of crude petroleum is far from the conservation of one of our greatest natural resources. In order to carburet water gas of an initial heating value of 325 B.t.u. per cu. ft., so that it will have a heating value of 570 B.t.u. per cu. ft., it is necessary to use 3 gal. of gas oil per 1000 cu. ft. of gas. The present market on gas oil is 12 cents per gallon. The enriching of 1000 cu. ft. of gas thus costs the producer 35 cents without any overhead, production or depreciation charges.

Natural gas, as produced in the Appalachian and Mid-Continent fields, has an average heating value of 1100 B.t.u. per cu. ft. It can readily be seen that less than 80 cu. ft. of natural gas has an enriching value equal to one gallon of gas oil. Natural gas can be mixed with blue water gas easily, safely and without any overhead, production, and depreciation charges and is, therefore, the ideal enricher of water gas, in regions where natural gas is available.

The manufacture of a domestic supply of water gas, enriched with natural gas, serves two purposes—(1) it conserves in the highest possible manner our natural resources of coal, oil and gas; and (2) it insures to the public an adequate supply at all times of a clean, uniform gas at the lowest possible cost.

The speaker described the three potential sources of raw material adequate for the production of a future domestic supply of manufactured gas as bituminous shale, oil and coal.

COLLOIDAL FUELS NEW ECONOMIC FACTOR

THAT STRANGE blend of oil and coal dust, known as colloidal fuel, was the subject of a paper presented by Dr. C. A. Sheppard.

Colloidal fuels is a name given to a distinct class of liquid to semi-liquid blended fuels which were developed in this country during and subsequent to the last two years of the war. They are composites, in which finely divided carbonaceous solids or semi-solids—various kinds of coal—are so suspended in and blended with liquid fuel oils as to form readily stable and atomizing fuels. They have been developed for burning with the regular types of atomizing burners using ordinary fuel oils, but have also possibilities for use in internal combustion engines of the Diesel and semi-Diesel type.

In the summer of 1917, Mr. Capstaff, of the Research Laboratory of the Eastman Kodak Co., made the query as to the possibility of powdered coal being used in conjunction with oil to supplement the latter for oil

burning ships. An adequate supply of fuel oil was no less vital to the Allies than of gasoline and lubricants, and at that time the German submarine campaign was threatening all these.

With such faith in the possibilities of colloid chemistry, some composites, containing up to 30 per cent of pulverized coal, with some other things added, were incorporated in some mineral oil by means of a small paint mill in the laboratory. These composites burned satisfactorily in an air-pressure oil fired furnace.

Through Dr. Mess, Director of the Laboratory, these results were referred to Lindon Bates, Engineering Chairman of the Submarine Defense Association, who was already devoting his attention to this very problem. At his instance and with Mr. Eastman's sanction, the possibility of colloidally combining pulverized coal and fuel oil was taken up by the Research Laboratory of the Eastman Kodak Co., in close and constant co-operation with the Submarine Defense Association under Mr. Bates' leadership.

Whatever the ultimate rating of colloidal fuels in commercial practice, it was a technical triumph that was effected when, from April to July, 1918, the U. S. S. Gem assigned by Admiral Benson, Chief of Naval Operation, to the Submarine Defense Association for experimental purposes, was successfully operated on a colloidal fuel containing 30 per cent pulverized coal as efficiently as with regular navy fuel oil.

The machinery for compounding these fuels is simple; it consists of a suitable mill for pulverizing coal, coke, etc., storage and blending tanks for the oil bases, and mixing kettles for compounding the composite fuel. Little modification in existing types of machinery is necessary, and the process is readily made continuous. The cost of manufacture may be reckoned at approximately $1.50 per ton, inclusive of the fixateur—a substance used in small quantity to stabilize the colloidal fuel.

The following is a brief summary of the properties of colloidal fuels:

1. They are liquid and handle and atomize for combustion like fuel oils.
2. They contain more heat units per gallon than fuel oils.
3. They contain very little moisture and ash.
4. The temperature at which they take fire is above 200 deg. F. They are immune from spontaneous combustion.
5. Not only are they vaporless up to high temperatures, thus avoiding explosive mixtures with air, but they may be fire-proofed by a "water seal" of an inch or more of water, owing to the fact that they are heavier than water.
6. Hence also they will sink if spilled blazing on the surface of water, i.e., they are self-quenching. Their fire risk is as low as anthracite coal, and far less than bituminous coal or ordinary fuel oil.
7. They are the most compact fuels known. The advantages of this are obvious: Increased radius for ships, lessened storage space in crowded cities.

By-Product Coke Oven Marks New Fuel Era

Coal can be conserved and a cheap and valuable gas made available for factory and kitchen through the use of the by-product coke oven, on the development of which an elaborate report was made by Messrs. F. W. Sperr, Jr., and E. H. Bird, of Pittsburgh.

These industrial chemists declared that the usage of the last 2 yr. has demonstrated that by-product ovens lead the beehive oven everywhere throughout the United States. Before the war, coke was made largely in the simple beehive oven, a device of sin, which permitted the tars to run to waste and the gases to be discharged into the air through a hole in the top of the structure. The by-product oven conserves what was formerly allowed to befoul air or land or stream. The tarry wastes are sources of valuable dyes and chemicals and the gas can be used for heating and lighting. The quality of the coke produced by the process is just as good as that obtained from the old beehive ovens. With the exception of ammonia and its compounds, all the primary products of the modern coke oven have much worth as fuel.

An examination of the fuel values will enable us to appreciate the great economy of a by-product coke oven as compared with the beehive oven which it is displacing. The coking of a ton of high grade coal in a beehive oven requires the consumption of 11,000 cu. ft. of gas, 9 gal. of tar, 4 gal. of light oil and 100 lb. of coke, which, in all, generate 9,388,000 B.t.u., or the equivalent of 671 lb. of coal. The by-product oven in making a ton of coke uses 4300 cu. ft. of gas, which is equal to 2,408,000 B.t.u., or equivalent to 172 lb. of coal. The beehive oven in making a ton of coke consumes 33.5 per cent of the heating value of the coal, while the by-product oven requires only 8.6 per cent. In 1918, there were coked in the United States 48,168,719 tons of coal. If this had been coked in by-product ovens, there would have been a saving of approximately 25 per cent, or 11,983,513 tons of coal.

Coke breeze, a material which was formerly discarded or used only for filling, is now being used with success for steam raising purposes, owing to the development of new stoking machinery—and, indeed, it is general practice for by-product coke plants to obtain all their steam from this fuel.

In recent years, an increasing number of by-product coke plants have been built for the primary purpose of supplying gas for industrial and domestic consumption. The Koppers oven, for instance, using part of its gas production for its own heating requirements, delivers a surplus of 60 per cent or even more of the total gas.

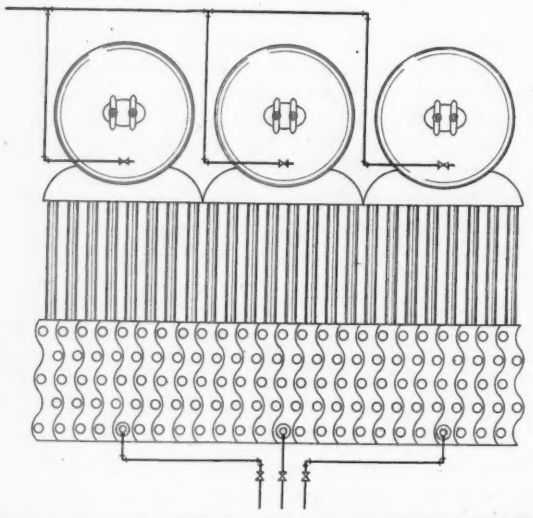
This gas, after it has been stripped of the by-product benzole, which is employed in chemical industry as base of explosives and dyes, has a heating value of 560 B.t.u. to the cubic foot.

The heating value can be increased by the retention of the benzole, by gas separation, or by enrichment, but each of these procedures in the long run is uneconomical both to the consumer and the producer of the gas, and is justifiable only when arbitrary local standards of high heating are enforced. Straight coke oven gas of 540 to 560 B.t.u. per cu. ft. constitutes an ideal gaseous fuel for industrial and domestic heating and the demand for it is constantly increasing. It is, when manufactured at the rate of 1,000,000 cu. ft. or more a day, the cheapest high grade artificial gas.

Tube Burnouts in Water-Tube Boilers

In a certain western boiler plant, much trouble was experienced with the burning out of boiler tubes in B. & W. boilers. These burnouts could not be attributed to the presence of boiler scale because the amount of scale present was very small. Much investigating was done and many theories advanced as to the reason for the frequent burnouts, and many things were tried as remedies, but without avail.

Finally it was noticed that the greater number of burnouts appeared under that drum that was farthest away from the inlet side, or the side from which the feed water was led to the drums. One theory was that possibly the reason for the burnouts was that the circulation of water was defective. Working upon this theory, samples were taken of the water contained in each of the three drums and this water was tested for concentration of salts.



ARRANGEMENTS OF FEED WATER AND SAMPLING PIPING

From the results of these tests, it was learned that the concentration of salts in the three drums was widely different. The concentration of the water in the drum nearest the inlet side of the boiler was about 170 parts per 100,000; the second showed about 350 and the third drum or the one farthest from the inlet side showed over 700 parts per 100,000 of salts This was a peculiar condition and further investigation was made.

The same condition was found to exist in all of the boilers and to all appearances was due to the fact that most of the water entered the first drum and kept the concentration down, while in the other drums there was a smaller supply of fresh water and consequently higher concentration.

In order to prove or disprove the theory that these conditions were causing the tube burnouts, the scheme was tried of blowing an amount of water out of each drum in proportion to its concentration. A test was made of the water in each drum before and after blowing and a tabulation prepared which showed the amount of water to be blown from each drum for any given concentration.

This method of blowing boilers was adopted and since its adoption, the number of tube burnouts has fallen off to almost nothing. Also, the amount of water saved is appreciable. In order to facilitate the taking of samples of water from under each drum, ¼-in. pipes were tapped into a lower cap under the center of each drum. The boilers are blown once each shift and samples taken accordingly. The whole scheme has proven a decided success.

Claude C. Brown.

Vacuum Pump Repair

Some time ago there came under my observation a vacuum pump with its cylinder sleeve so badly worn that it lost vacuum very rapidly. At first it was suggested that the worn sleeve be replaced by a new one. Such sleeves, however, are difficult to remove so, at my request, the following repair was made as shown in the accompanying sketches. This proved entirely successful.

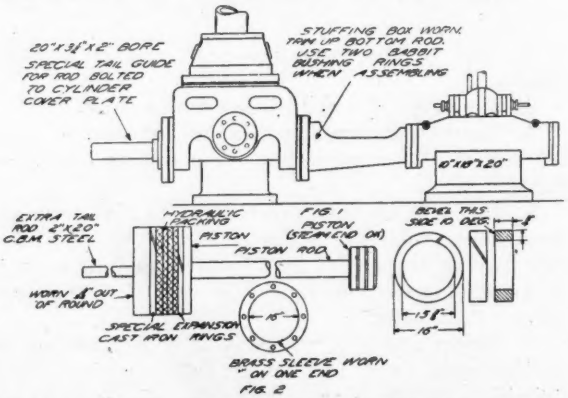

20"x 3½"x 2" BORE
SPECIAL TAIL GUIDE FOR ROD BOLTED TO CYLINDER COVER PLATE
STUFFING BOX WORN. TAKE UP BOTTOM ROD. USE TWO BABBIT BUSHING RINGS WHEN ASSEMBLING
EXTRA TAIL ROD 2"X20" C.R.M. STEEL
HYDRAULIC PACKING
PISTON
PISTON ROD
WORN ⅛" OUT OF ROUND
SPECIAL EXPANSION CAST IRON RINGS
BEVEL THIS SIDE TO DEEP
BRASS SLEEVE WORN ⅛" ON ONE END
FIG. 2

FIG. 1. VACUUM PUMP, SHOWING ADDITION OF TAIL ROD AND SLEEVE

FIG. 2. SHOWING PISTON RINGS AND METHOD OF INSTALLING

First, two cast-iron split rings were made having a diameter of 16 in. These were placed on the piston, as shown in Fig. 2, with both split ends on top and four layers of hydraulic packing between them. With this

arrangement the pump was placed in commission and operated for about 14 days.

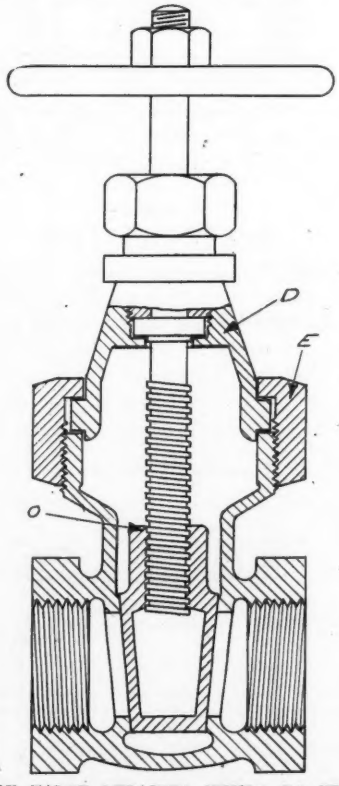
Examination showed a full bearing of the piston against the cylinder walls, with a tendency to wear the cylinder round again.

The addition of a tail rod fastened to the piston and a tail-rod sleeve attached to the cylinder cover plate, as shown in Fig. 1, completed the repairs.

It will be apparent, when it is known that a piston of this type weighs about 200 lb., that the friction, when the piston is at the end of its stroke, will be considerable. The pump in question is a 10 by 16 by 20-in. When it was first examined there was a space of 9/32 in. between the top of the piston and the cylinder sleeve at the point where the piston was at its maximum outer stroke. The installation of a tail rod and sleeve transfers the weight of the piston to the tail rod, thus equalizing the pressure of the piston against the cylinder sleeve throughout the length of the stroke. This results in a better vacuum, less operating expense, and continuous service. The pump will now give good service for another 3 or 4 yr. OTTO DORTHEN.

Repairing Gate Valves While in Service

POWER PLANT men are sometimes confronted with the task of renewing parts of a gate valve on lines where it is imperative that the water must not be shut off.



TYPE OF VALVE REPAIRED WHILE IN SERVICE

This problem was encountered and easily solved at a hydroelectric plant, when a valve stem broke in the transformer cooling water main. As the pipe was connected to the forebay, there was no chance to shut off the water.

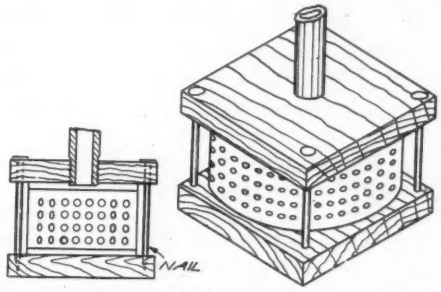
The valve was, therefore, taken apart in such a manner that the gate was left in place and no inconvenience resulted from leaking water. This was accomplished as follows:

The union ring, E, was screwed off, thus loosening the bonnet, D, from the valve body. Then, by turning the valve wheel to the right, the stem was removed while the gate, O, was left in place.

Different valves offer different problems. Most of them, however, can be taken apart in a manner similar to this and it is hoped that this kink may assist somebody in avoiding a wet job. L. W. WYSS.

Oil Stove Wick Frame Used as Strainer

A CONSTRUCTION GANG recently needed several small strainers for suction pipes and had nothing out of which to make them. The cook of the outfit unconsciously

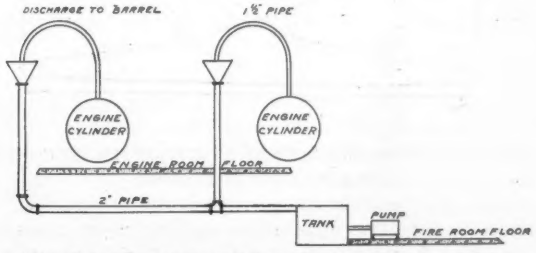


SHOWING USE OF OIL STOVE WICK FRAME AS STRAINER

solved the problem by discarding some old oil stove burner wicks while the matter was under discussion. The wick stubs were burned out, leaving the frame which had a perfectly satisfactory mesh for a strainer. It was secured between two blocks of wood, one of which had a hole for the pipe. Several of these afforded just what we needed in the line of strainers. This improvised job may suggest a solution of strainer trouble to somebody under a similar difficulty, as these frames are readily procured around any place where oil stoves are in use. FRANK W. BENTLEY, JR.

Remedy for Feed Pump Difficulty

I AM ENGINEER in a sardine canning factory which has always had a steam engine until this year, when we installed two 25-hp. Fairbanks-Morse crude oil en-



ARRANGEMENT FOR LIFTING HOT WATER TO PUMP

gines. We still have to use the boiler for cooking and heating purposes. I used to feed the boiler with a feed pump, heating the water with the exhaust from the steam engine. I had to put the pump away this year and use the inspirator altogether, I thought. When the

contractors installed the crude oils, they also installed a small pump to each engine to pump the water back to the pressure tank. The water goes through the engines and discharges into a barrel beneath the engine room floor. This water is from 140 to 180 deg. F.

They soon found they could not lift hot water with the pumps. I hit upon an idea. I put a 2-in. pipe line under the engine room floor, connected the two overflows to this, and ran it to the fireroom into a tank on the floor, the top of the tank being about two feet below the discharge pipe on the engine. I set my pump on the floor beside this tank and as the tank and pump were on a level with each other, the water would flow into the pump and was forced from there to the boiler. I also put a small steam pipe in the tank which keeps the water boiling. The water from the two engines will keep the boiler supplied. THEO. W. WILDER.

Change in Eccentric Setting Eliminates Pound

SOME TIME ago, I was called upon to make adjustments in a 12 by 36-in. engine (Corliss) making 106 r.p.m. The crank end dashpot was sluggish and the

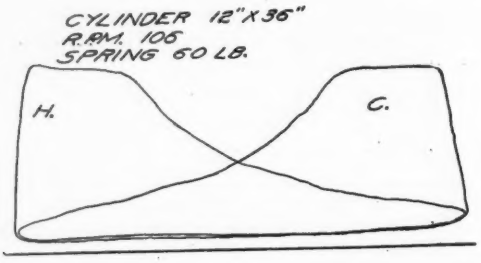


FIG. 1. ORIGINAL DIAGRAM TAKEN FROM ENGINE

engine pounded. The bearing was up fairly well, also the crankpin box so when the indicator was put on, card shown in Fig. 1 was secured.

This shows late steam admission, very much so on the crank end, and no compression. The eccentric was

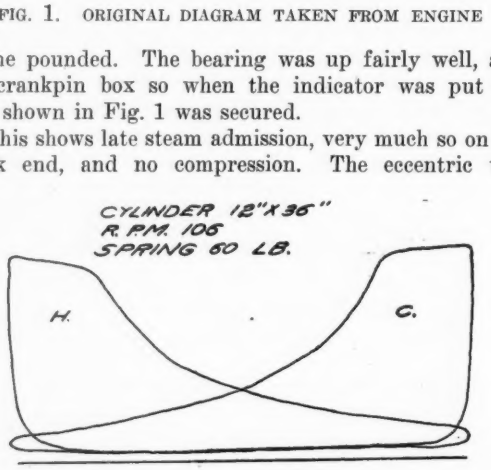


FIG. 2. CARDS TAKEN FROM ENGINE AFTER CHANGING POSITION OF ECCENTRIC

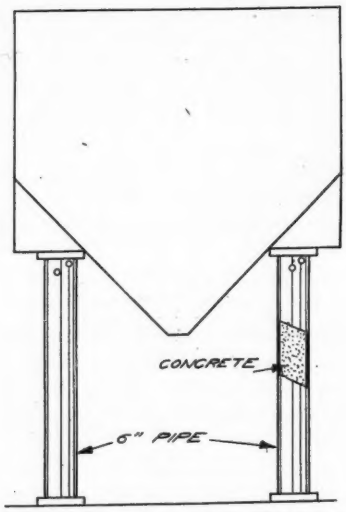
turned in direction of rotation, making an improvement. Card Fig. 2 was taken after the final adjustments were made, and these included changing all the valve rods and governor rods leading to the knockoff cams. The pound in the engine vanished, without bothering the main bearing box or the chankpin box.

Recently I took the knock out of another engine by lengthening the exhaust valve rods a trifle.

TOM JONES.

Strengthening Pipe Leg Supports

WE HAD in service a fairly large ash tank, which was supported by four legs made up of 6-in. pipe and flanges. We increased our load and also needed more ash storage, and desired to add a number of feet in height to the tank. Fearing that the supports might not be strong or rigid enough for the greater load, we decided to strengthen them rather than attempt to replace them. This we did by boring two 1-in. holes near the top of the pipe leg supports, into one of which we poured a

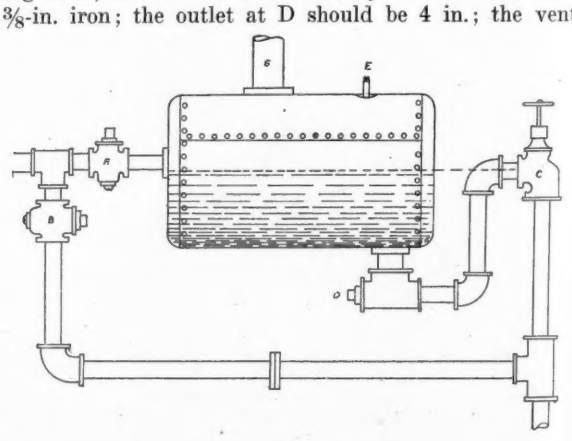


PIPE LEGS FILLED WITH CONCRETE

fluid concrete, the other hole acting as a vent to allow the displaced air to escape. We filled the pipe legs solid, as shown, and thereby secured some extra strength and rigidity. M. A. SALLER.

Safe Blowoff Tank

THE ACCOMPANYING sketch shows a blowoff tank outfit which I consider safe. For a 2-in. blowoff pipe, entering at R, the tank should be 30 by 60 in. made from ⅜-in. iron; the outlet at D should be 4 in.; the vent

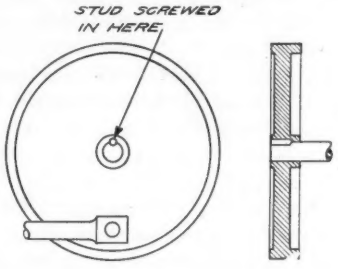


BLOWOFF TANK AND CONNECTIONS

pipe G, 2½ in., open to the atmosphere. When the tank requires washing, the plug at D can be removed, and the washing done with a hose pipe stream through the handhole at E. If for any reason the tank has to be cut out for a time, the valves A and C are closed and valve B is used as a blowoff. JOHN THORN.

Fastening a Loose Crank Disk

WE HAD trouble with our 75-hp. slide-valve engine; sometimes it would stop, and at other times it would run in the opposite direction from that for which the valves were set. We reset the valve each time and wondered why it slipped. Finally somebody suggested that possibly the crank disk was loose on the shaft. On investigation, this proved to be so; the disk had been shrunk on the shaft, but had worked itself loose.



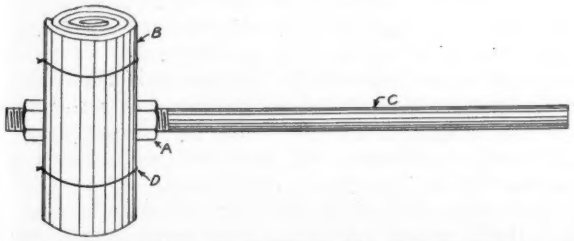
SHOWING HOW THE DISK WAS SEAMED

To fasten the disk, I drilled a ½-in. hole half in the disk and half in the shaft, as shown in the illustration, tapped it and screwed in a stud. The disk was thus securely held in place and the engine gave no further trouble.

EARLE H. GRAY.

Leather Belt Hammer

GALVANIZED IRON, or tin, sheet metal tanks used around the power plant to hold oil, often get dents in them, with the result to be expected; their neat appearance is destroyed. Perhaps it is an oil filter that has its side dented in. Using a hammer to knock back the



HAMMER MADE FROM PIECE OF LEATHER BELT

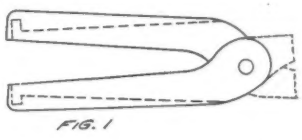
dents is apt to result in a cut tin. Take a short piece of old single belting, roll it up and tie it together with a couple of pieces of string or wire, D, in Fig. 1. Bore a hole through the roll of belt and use a piece of ¾-in. iron pipe, C, for a handle, using a lock nut, A, on each side of the belt. With this hammer the dents can be knocked back, leaving the sheet iron in fine condition, no danger of a cut, and no small dents left, as would be quite probable and possible if a metal hammer were used.

JAMES. E. NOBLE.

Three Useful Kinks

WHEN GAS pliers break, they can still be of some use. I made a pair of calipers by cutting the jaw-ends off flush, heating the handles and flattening them to a thickness of about 3/16 in. I then marked off the legs of calipers with a scriber on the flattened part and filed down to the scriber mark, afterwards polishing the tool up bright. Any form of caliper can be made this way. Figure 1 should show the idea clearly.

Figure 2 shows a pipe clamp I am using on blow-holes in pipe. A piece of rubber sheet placed between the sheet iron and the hole will stop any leak in steam pipes. A paste of litharge and glycerine on the rubber will make a lasting job.



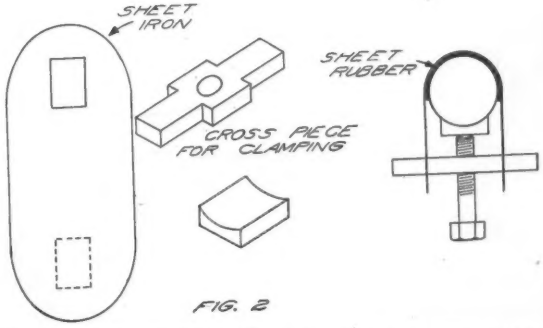
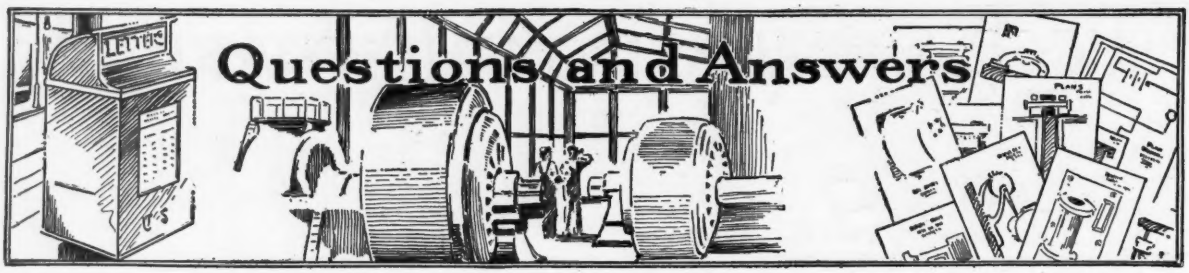


FIG. 1. HOW BROKEN PLIERS CAN BE MADE INTO CALIPERS
FIG. 2. DETAILS OF HANDY PIPE CLAMP

In a hotel plant where I was in charge of the auxiliaries, I was often troubled with the piston rings getting caught when I tried to slide the piston in place. One day I transferred five well-worn steel table knives from the hotel kitchen to my tool drawer and my troubles were over. Placing a knife on each side of the split in the ring and the other three at equal distances around the piston made it slide right into the cylinder.

E. MATZAN.

DON'T simply see how you can "put in the day." See how much you can put into the day.—Forbes Magazine.



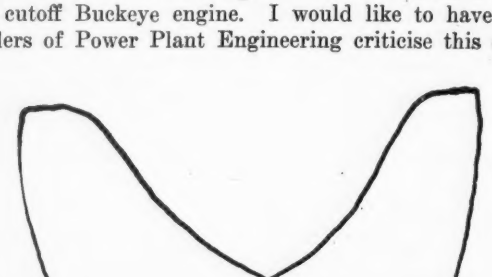
Operating Oil Engines

WE HAVE just installed two 60-hp. De La Vergne Diesel type of oil engines direct connected to 9 by 9-in. ammonia compressors of like make. These units, which operate at a speed of 240 r.p.m., are at present using kerosene and waste oil for fuel.

Up to the present time, these machines have run with a great deal of satisfaction to us; however, I have not had any previous experience with oil engines and wish that some of the readers of Power Plant Engineering would contribute a few articles relative to the care required by such oil engines and the means by which they may be operated most economically. A. D.

What Improvements Can Be Made?

THE ACCOMPANYING diagram was taken from a Riding cutoff Buckeye engine. I would like to have the readers of Power Plant Engineering criticise this card



CARDS FROM A BUCKEYE ENGINE

and make suggestions for improvement. Boiler pressure, 80 lb.; revolutions per minute, 145; bore and stroke, 15¼ by 27 in.; scale of spring, 40. The head end card is shown at the left. J. C. M.

Refrigeration Problem; Brine Tank Capacity

I HAVE a cold storage and creamery. There are about 118,000 cu. ft. of cold storage divided into rooms as follows: Ice cream hardening room, 12 by 12 by 6 ft.; sharp freezer room, 36 by 12 by 9 ft.; one butter storage, 24 by 36 by 9 ft.; another butter storage, also 24 by 36 by 9 ft.; four egg storage rooms, 24 by 36 by 9 ft.; one other, 36 by 48 by 9 ft.; and one cream and milk storage, 36 by 48 by 9 ft. In addition to this there is a cooler 32 by 12 by 9 ft.; one for milk cooling and butter hardening, 12 by 48 by 9 ft.; also a couple of small rooms having a combined cubic capacity of 12 by 12 by 9 ft. We have three ice cream freezers of a horizontal type and of ten gallons capacity each, a Davis milk cooler, capacity 400 gal. per hour, a cream cooler with a capacity of 100 gal. per hour, each cooler having a water section and brine section.

The ice cream machines and milk coolers are operated by brine, the rest of the plant by direct expansion. We have two 12-ton double-pipe brine coolers with return from freezers and milk cooler going through coolers. Should that not go through double-pipe cooler first and then to freezers and milk coolers and return to brine tank? It appears to me as if they were connected backwards. Is the brine tank large enough? It is a 3 by 3 by 20-ft. unit.

We now have two Wolfe Linde machines each of 25-ton capacity. Is this of sufficient refrigerating capacity? I am in doubt about this, as I am short about 25 tons when everything is working. All of the rooms are on one suction line and I cannot maintain enough back pressure to keep the low temperature room at a desired temperature. I have a back pressure usually of 16 to 22 lb. and in extremely hot weather 25 lb. The insulation in most of the rooms is poor. As there will have to be some changes made this fall, I would like your opinion on the foregoing questions. We usually get along quite well when there are no ice cream machines running; but when everything is in operation, I find I cannot hold the brine down to about 8 or 10 deg. as desired. J. D.

A. In checking up the cubic feet of space in each room, I find the total amount of cold storage space to be 92,448 cu. ft. instead of 118,000. This is a difference of 25,552 cu. ft.

The most reliable way to figure refrigeration capacity is to consider each room separately and find out just how much heat leakage there is from the outside to the inside of the room.

The heat that leaks through the walls of a cold storage room is a big factor when refrigeration is considered. As a rule, it requires about as much machine capacity to take care of this leakage as is required to reduce the temperature of the produce that is put into the room. To arrive at this figure, the average temperature outside of each wall, floor and ceiling must be known, also the temperature of the room.

One room standing by itself and having all four walls and the floor and ceiling exposed to the outside temperature will have a greater heat leakage into it than if the room were surrounded by other cold storage rooms.

In the cold storage now being considered, we will assume that the rooms are so heated that the average temperature outside of the rooms is 60 deg. F. This will allow for outside walls where the temperature is 80 or 85 deg. and for inside walls where the temperature on both sides may be nearly the same. It also allows

for floors and ceilings where cold rooms are one above the other.

We must figure the total wall, floor and ceiling area of the rooms that are to be held at the same temperature. Four egg storage rooms 24 by 36 by 9 ft. have a total exposed area of 11,232 sq. ft. One egg room 36 by 48 by 9 has 4968 sq. ft. This gives a total exposed surface of 16,200 sq. ft. for the five rooms.

The average temperature of egg storage rooms is 33 deg. The temperature difference between the 60 deg. average outside atmosphere and the egg rooms is 27 deg.

For ordinary insulation, there will be a heat loss of 3 B.t.u. per degree temperature difference per square foot surface during 24 hr.

Then the heat that enters the room from the outside will be 16,200 by 3 by 27 or 1,312,200 B.t.u. To this must be added 20 per cent to allow for lights, open doors and workmen. This gives a total of 1,574,640 B.t.u.

One ton refrigerating capacity is equal to 288,000 B.t.u. Then it is plain that just about 5½ tons refrigerating capacity is required to take care of the heat leakage into the egg rooms.

Two butter storage rooms 24 by 36 by 9 ft. have exposed surface totaling 5616 sq. ft. Butter is generally stored in rooms having a temperature of 10 deg. F. above zero. This gives a temperature difference of 50 deg. Then $5616 \times 3 \times 50 = 842{,}400$ B.t.u. This is equal to nearly 3 tons refrigerating capacity. Add 20 per cent and we have about 3½ tons.

The exposed surface of the ice cream hardening room, 12 by 12 by 6, is 576 sq. ft. As a hardening room is held at a temperature not above zero, the difference between the inside and outside of the room will be 60 deg. Then $576 \times 3 \times 60 = 103{,}680$ B.t.u. or about 0.4 of a ton refrigerating capacity after 20 per cent is added.

This line of figuring shows plainly the great saving that can be effected by careful consideration as to the location of rooms when erecting or rebuilding a cold storage plant.

If the ice cream hardening room is surrounded on all sides as well as above and below by cold rooms, the temperature difference can be lowered to 40 deg. or less. Then, if glass insulation is used which allows 1.5 B.t.u. leakage per square foot per 24 hr. per degree temperature difference, we can obtain the following: $576 \times 1.5 \times 40 = 34{,}560$ B.t.u. or just one-third of what was required under the first condition.

The exposed surface of the sharp freezer is equal to $36 \times 12 \times 9 = 1728$ sq. ft. The temperature difference is 60 deg. Then $1728 \times 3 \times 60 = 311{,}040$ B.t.u. Add 20 per cent = 373,248 B.t.u., or about 1.3 tons.

One cream and milk storage will be held at a temperature of 35 deg. F., giving a temperature difference of 25 deg. The exposed surface of this room $36 \times 48 \times 9 = 4968$ sq. ft. Then $4968 \times 3 \times 25 = 372{,}600$ B.t u. Add 20 per cent, or 447,120 B.t.u., which gives us 1.6 tons.

The exposed surface of a cooler $32 \times 12 \times 9 = 1560$ sq. ft. The cooler is held at a temperature of 35 deg. which gives a temperature difference of 25 deg. Then $1560 \times 3 \times 25 = 117{,}000$ B.t.u. Adding 20 per cent gives 140,400 B t.u., or about ½ ton.

A milk cooling and butter hardening room is carried at an average temperature of 35 deg. This gives a temperature difference of 25 deg. The exposed surface of a room $12 \times 48 \times 9$ is 2232 sq. ft. Then $2232 \times 3 \times 25 = 167{,}400$ B.t.u. Adding 20 per cent gives 200,880 B.t.u. or about 0.7 tons.

The small rooms have an exposed surface of 720 sq. ft. If the temperature difference is 20 deg., then $720 \times 3 \times 20 = 43{,}200$ B.t.u. Adding 20 per cent gives 51,840 B.t.u., or about ¼ ton refrigerating capacity.

The total refrigerating capacity that is required to take care of the heat that enters through the insulation will be within a fraction of 17½ tons.

A safe rule to follow in estimating the amount of refrigeration required in the making of ice cream is to allow 1200 B.t.u. for each gallon made, about 900 B.t.u. being required for the actual freezing of the batch and the remaining 300 B.t.u. for preparing the batch for freezing and for the hardening of the cream after it leaves the freezer.

With three freezers operating 10 hr. a day and having a total capacity of 30 gal. an hr., the removal of 360,000 B.t.u. will be necessary. This amounts to 36,000 B.t.u. an hour and represents three tons refrigerating capacity an hour during the time that the freezers are operated at full capacity.

Four hundred gallons of milk cooled in 1 hr. from 60 to 32 deg. F. will require the removal of 96,000 B.t.u. This means 8½ tons refrigerating capacity during the cooling period.

The cream cooler will take very nearly two tons refrigerating capacity an hour while cooling 100 gal. of cream an hour.

Now, the refrigeration required in the handling of the ice cream, milk and cream amounts to 13½ tons each hour that the ice cream freezers and the milk and cream coolers are all operated at the same time. Arrangements should be made so that this load can be divided and not all the cooling done at the same time. With everything going at the same time, the total amount of refrigeration required for taking care of the heat that leaks through the insulation and for the ice cream and milk department will then equal 17½ and 13½ or 31 tons. This leaves 19 tons to handle the produce that is put in the cold storage rooms.

To estimate the refrigeration required for the produce, the weight of the different kinds put in must be known. Then multiply the weight in pounds by the specific heat and by the difference between the temperature of the incoming article and the temperature of the room. This gives the heat units to be removed.

For example: Five thousand pounds of butter to be cooled from 60 to 30 deg.; $5000 \times 0.5 \times (60 - 30) = 75{,}000$ B.t.u. This represents about ¼ ton refrigerating capacity in 24 hr.

Better results are obtained by taking the pump suction from the brine tank and discharging through the double-pipe brine cooler, then to the freezers and milk coolers and return to the brine tank. This gives the greatest amount of heat exchange.

There should be two separate ammonia suction lines to the compressors cross connected and provided with valves so that they can be used separately or together.

The low temperature rooms should be operated with one compressor or, if the load is light, one end of one compressor should be used. In this way, the low back

pressure necessary for low temperature work can be maintained on such coils as needed. Then the warm rooms can be operated with high back pressure. In this way, the capacity of the entire plant will be increased.

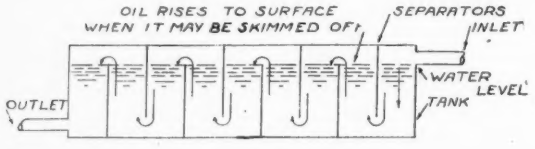
The brine tank is large enough for the work required of it. A. G. SOLOMON.

Oil Separator Problem

I WANT TO BUILD a cheap filter to take the oil out of the exhaust steam from a 75-hp. steam engine. All the oil that would be in this steam would be that which went through the lubricator. The exhaust steam goes through coils, so that it comes out condensed. I would like to use this water again for feed water. Would this be practical? H. L. G.

A. It would be preferable to install an oil separator in the exhaust line between the engine and the condensing coils.

If, however, you should desire to use a filter instead, we would suggest one similar to the sketch shown herewith.



GRAVITY OIL SEPARATOR

This would consist essentially of a closed tank containing the separating walls as shown. The course of the water through this filter would be as shown by arrows and without doubt you would be able to skim all the oil from the surface of the water, provided the filter is made large enough to keep the rate of flow through it low.

Answers to Examination Questions

THERE APPEARED on pages 762-3 of the Aug. 1 issue of Power Plant Engineering a list of 20 questions on general power-plant subjects, propounded by E. G. M. The following answers are submitted, in a more or less condensed form, with the thought that they may clear up these questions for the readers.

1. The highest safe working pressure in a horizontal boiler is determined from the following equation:

$$WP = \frac{2\,S\,t\,e}{f\,D}$$

in which s = tensile strength; t = thickness of shell; e = joint efficiency; f = factor of safety; and D = diameter of shell.

The lowest factors of safety used for steam boilers, the shells or drums of which are directly exposed to the products of combustion and the longitudinal joints of which are of lap-riveted construction, according to the Massachusetts Rules, shall be as follows: 5 for boilers not over 10 yr. old, 5.5 for boilers over 10 and less than 15 yr. old, 5.75 for boilers over 15 and not over 20 yr. old, 6 for boilers over 20 yr. old.

2. To determine the area of pop or lever safety valves, use the following formula:

For a bevel seated valve, 45 deg. angle

$$A = \frac{W\ 70}{P} \times 11$$

and for a flat seated valve

$$A = \frac{W\ 70}{P} \times 8$$

in which

A = area of direct spring loaded valve in sq. in. per sq. ft. of grate surface.

W = weight of water in lb. evaporated per sq. ft. of grate surface per hour.

P = pressure (absolute) at which valve is set to blow.

3. To determine the pressure at which a safety valve is set to blow, use the following equations:

a. lever valves

b. pop valves.

$$\text{a.}\quad P = \frac{(WL + wd + w_1 d_1)}{0.7854\,D^2\,d_1}$$

where P = pressure at which valve is set to blow; W = weight of counter balance; L = distance of counter weight from pivot; w = weight of lever; d = distance of the center of gravity of the lever from the pivot; w_1 = weight of valve; d_1 = distance of valve from pivot; and D = diameter of valve

$$\text{b.}\quad P = \frac{W}{0.7854\,D^2}$$

W = force exerted by spring; P and D as before.

4. To find the number of braces required to support properly the flat surface above the tubes of a horizontal boiler, the following equations may be used:

$$N = \frac{p \times \text{area of unsupported head} \times f}{TS \times 0.7854 \times D^2}$$

where area of unsupported head $= \frac{4}{3}(H-d-2)^2 \sqrt{\frac{2\,(R-d)}{(H-d-2)}} - 0.608$; N = number of braces; D = diameter of braces; p = maximum allowable working pressure; H = distance from top row of tubes to shell; TS = tensile strength of the material; f = factor of safety, and d = distance supported by the shell as given by the relation:

$$d = \frac{5 \times T}{\sqrt{p}}$$

in which

T = thickness of head in sixteenths of an inch, p, as in the foregoing.

D should be so chosen that the distance, S between stays shall be as determined by the following equation:

$$S = \sqrt{\frac{66 + (T+1)^2}{p}} + 6$$

5. Dimensions of riveted joints are as given by empirical rules:

Riveting	d	p
Single	2⅓ t	2⅜ d
Double	1.8 t	4.1 d

6. The pitch of stay bolts for this 20 by 32-in. area holding 120 lb. pressure is

$$p = \sqrt{\frac{C\,T^2}{p}}$$

where P = maximum allowable working pressure, T = thickness of plate in sixteenths of an inch, p = maximum pitch measured between rows of stays, and

C = 112 for screwed stays — T not greater than 7/16 in.
= 120 for screwed stays — T greater than 7/16 in.
= 135 for screwed stays fitted with single nuts outside plate.
= 150 for stays with heads not less than 1.3 in. diam. stay.
= 175 for stays with both inside and outside nuts.

Size of stay bolts.

$$Ap = S \times 0.7854\ d^2$$

where

A = area of section, p = working pressure, S = allowable stress in bolts = 8000, d = diameter of bolt.

$$20 \times 30 \times 120 = 8000 \times 0.7854\ d^2$$

d = 1⅛-in. say.

7. There are 2 rivets per unit in a double-riveted seam and 5 per unit in triple-riveted butt joint on each side of the joint, or 10 in all.

8. A horizontal boiler, 72 in. diameter, 18 ft. long with 70 4-in. flues, will hold 263 cu. ft. water up to the mean water level.

9. To set two horizontal return tubular boilers.

The wall construction may be made according to any one of a number of methods. A good design is a course of No. 1 fire brick backed by No. 2 and then common brick to a depth of 16 in. This wall is then covered with 2 in. of 85 per cent magnesia and then cased with steel.

The division wall should be from 20 to 32 in. thick, preferably constructed entirely of No. 1 brick. It should be built in two sections not bonded together in any way. The wall sections at the furnace should be battered in from the grate level to the closing-in line near the center of the shell. The construction should be such that will allow for expansion of the setting when the boiler is fired. The bridge wall should not be connected to side walls.

The height above grate will vary with the fuel used from 30 to 40 in.

The grate area is practically proportional to the heating surface, about 1 to 45 or 50.

A boiler of this size can be supported by brackets resting on the walls, six or eight per boiler will be sufficient. Rollers should be fitted under all but the front brackets to permit free expansion.

10. In an inspection of boiler, the following points should be considered:

Scale formation, soot deposits, pitting, crystallization of shell, tube and stays, tightness of stays, condition of seams as to cracking, grooving, pitting and calking, examination of joints for rivet shear crushing, tension strains in stays, braces, etc. Condition of fusible plug, safety valve, stop valve, steam gage, water column, and try cocks. An external inspection should investigate condition of grate and brickwork, leaks in setting and of shell as to blisters and bags, uptake and draft conditions.

11. Boiler explosions are caused when:

(1) Steam pressure builds up beyond the resisting strength of the structure. This, of course, can be obviated by properly functioning safety valves.

(2) Rents occur in the structure. This causes the pressure to drop suddenly, thus releasing the heat stored in the water. This water flashing into vapor has great destructive effects. Rents occur at weak spots which should be located during the course of an inspection.

Failures of boilers are usually due to wear and tear produced chiefly by continuous expansion and contraction, to corrosion, to overheating, and to carelessness. Overheating may be caused by low water or by scale or grease. Important fixtures such as main stop valves may become attacked, or the main steam header may be burst by water hammer, thus causing a release of pressure, which, if sudden enough may be followed by an explosion. Explosions of water-tube boilers do not produce the dire effects of those of fire-tube boilers.

The best way to prevent explosions is to employ intelligent labor and not neglect proper and systematic examination.

12. The steam cutoff in a direct acting pump is about at full stroke and can not be less.

13. The size of a boiler feed pump can be determined from the water requirements of the boiler.

Pump displacement in cu. ft. = cu. ft. required by the boiler per minute divided by 100 minus per cent of slip allowable, and by the strokes per minute.

Feed pipes should be of such size that the velocity will not exceed 250 ft. per min.

14. If a pump normally in good condition should suddenly cease to deliver, the chances are that the supply is shut off or the valves are stuck open.

15. An engine equipped with an automatic cutoff valve possesses advantages over one with a simple slide valve in that the steam consumption would be less. There would be no difference in horsepower if the speed and work were the same.

16. The size of steam and exhaust pipes to and from an engine is determined from the steam consumption of the engine and the allowable velocity in the pipe or allowable pressure drop—about 1 lb. per 100 ft. of pipe.

$$D = \sqrt{\frac{W \times hp \times 144}{d \times 3600 \times 0.7854 \times V}}$$

where D = diameter of pipe in in.; W = wt. steam per hp. per hr.; V = allowable velocity, about 600 ft. per sec.; d = density of steam.

The exhaust pipe will be larger than the steam pipe because of the increased specific volume of the steam.

17. To change the speed of a slide, automatic or Corliss engine, simply change the governor regulation by either changing the spring tension or the governor drive, in the case of a Corliss.

18. In order to set the valves correctly on an engine, the positions for maximum efficiency of admission, cutoff, release, and compression should be determined from a Zeuner or Bilgram valve diagram and so set on the engine. The degree of eccentricity should also be determined from this diagram.

19. A slipping governor belt would tend to increase the speed of the engine.

20. A thump in an engine is usually produced by loose connecting rod pins or loose bearings or excessive water coming over with the steam.

POWER PLANT ENGINEERING

Trade-Mark, Reg. U. S. Pat. Office

Issued the 1st and 15th of each month. Established over 24 yr.

Published by the TECHNICAL PUBLISHING CO.
537 South Dearborn Street, Chicago.
New York Office, 150 Nassau St.

Subscription price $2.00 a year in postal zones 1, 2, 3, 4 and 5, which include all postoffices within a distance of 1400 miles from Chicago.

Subscription price $2.50 a year in postal zones 6, 7 and 8, which include all postoffices more than 1400 miles from Chicago.

Copies, current issue, 15 cents; back numbers, 25 cents.

Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

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Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the act of March 3, 1879.

Member, Associated Business Papers.
Member, Audit Bureau of Circulations.

Circulation of this issue 22,000

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Coal in Storage Today

In whatever direction we look we see the specter of a coal famine looming up ready to overwhelm us during the coming winter. Nearly every newspaper and magazine which we pick up warns us to get our coal supply in hand before the heating season is upon us, for when that time arrives the demand for domestic purposes will absorb the output and industries will suffer. This advice is good and founded upon conditions which in the main are anything but encouraging. But of what value is it to be told to buy coal when there is none in the market to be had at any price? What the engineer really wishes to know is the facts in regard to the coal on hand and the probable production as compared with former years. With these in his possession he can form his own conclusions regarding the necessity for laying in a surplus as an extra insurance against a shutdown, the price that he can afford to pay for it if coal can be had, and if it cannot, he can determine the necessity of turning to some other fuel as a standby.

Just as this issue is going to press there comes a report from the U. S. Geological Survey, the Bituminous Coal Commission and the Council of National Defense on the stocks of coal in the hands of consumers March 1 and June 1, 1920. The data given in this report and the weekly bulletin issued by the Government is the most authentic information available for making an analysis of the coal situation, yet these data are not as complete as might be wished for.

It is estimated that on June 1 the commercial stock of bituminous coal on hand was 20,000,000 t. By commercial stock is meant that in the hands of railroads, industrial consumers, public utilities and retail dealers. No figures are given for any other year on June 1 with which this can be compared, the nearest to this date in another year was July 15, 1918, which was an abnormal year and would be an unjust comparison. On this date the stock was 43,700,000 t., over twice what is reported for June 1 of this year. On October 1, 1916, 27,000,000 t. were in stock and on the same date in 1917 28,100,000 t. were reported in reserve. While these were not altogether normal years owing to increased industrial activity caused by the European war, they do give us something from which to judge, and we find that the June 1, 1920, figure is by comparison 7,000,000 and 8,000,000 t. short. During the interval between June 1 and Sept. 4 this year the production has averaged approximately 1,750,000 tons daily which, we have no doubt, has exceeded the consumption somewhat (this runs about one and a third million tons a day), and it is more than likely that by October 1 we shall have accumulated a stock on hand, equivalent to that of 1916 or 1917, unless foreign exports have been excessive; on the other hand the production during the first 211 days of 1917 was 372,953,000 t. while in 1920 over the same period it has been only 358,464,000 t. or 14½ million tons short of the lowest year recorded in the report with the exception of 1919, which started with an immense stock in reserve. And it must be remembered that it was during the winter of 1917 and 1918 that a fuel famine was experienced in many sections of the country.

While the average stock on hand June 1 was sufficient for two weeks and one day, by sheer good fortune or

perhaps foresight on the part of consumers, it is noted that those states farthest from the coal mines have, in general, the greatest supply of coal in reserve. For example the industrial plants, other than steel and by-product, of New England had on June 1 five or more weeks' stock on hand, likewise those of the Rocky Mountain region, while all states, with the single exception of Minnesota, touching the Great Lakes and several adjoining them had less than three weeks' stock to draw on. Evidently those who have coal at their door see little need of keeping much in reserve, which is, after all, true economy, for it saves interest on investment, provided the transportation system does not break down and the miners are kept at work, neither of which, we have learned to our sorrow, can be absolutely depended upon. Since the first of June service orders have been in effect which tend to increase shipments to New England and on the lakes to the Northwest, and no doubt consumers have taken advantage of these orders to stock up their supplies.

The situation is grave, indeed, but it is hoped that with the railroads back in the hands of their owners and with freight rates recently increased, the principal cause for lack of production, that of transportation disability, will be somewhat relieved. Miners' strikes have also caused considerable loss of output in some localities and these for the most part have been settled so that further serious trouble along this line is not looked for.

In the next issue of Power Plant Engineering, the report mentioned above will be published together with maps showing the stocks of coal on hand in various states. It is our suggestion to engineers who find that their supply of coal is low, that through their local organization they make a survey of stock on hand in all the various industries and present their findings together with recommendations for relieving the situation to the Chamber of Commerce of the city. These organizations usually represent the financial interests of the city and their influence upon railroads and coal mine operators is sure to have quicker results than the most strenuous efforts of individuals in need of fuel.

Off Duty

In one of the world's largest central stations some time ago, a workman who was doing some repair work in the vicinity of the switchboards, looked for a convenient place to set his dinner pail and found one —he placed it upon (and across) the 250 v. exciter bus bars. Then the fun began. After the fire department and ambulance had departed, there remained very little of the aforementioned dinner pail. Now, whether it was with the intention of warming his lunch that he did this, we do not know, nor care, but we certainly know that he did not take into consideration the laws of cause and effect. He should have known better. Any person working in such a place should know that vaporized sheet iron or whatever his dinner pail was made of, does not go well with sandwiches. Had he been acquainted with the simple laws governing the flow of electricity through conductors, he might have calculated the current which served to vaporize his dinner pail. Ohm's law would have told him that.

And speaking of laws, that reminds us, "Are these laws always applicable—even where such commonplace things as dinner pails are concerned?"

Take our laws governing the flow of electricity through conductors, for instance. At all ordinary temperatures the resistance of a conductor varies in a definite manner according to the temperature. For copper this law tells us that for every degree C. rise in temperature the resistance will rise .393 of 1 per cent of the resistance of the conductor. Thus, it would seem to be an easy matter to calculate the resistance at almost any other temperature. Within certain limits, yes, we can do this, but in all cases, no.

For a number of years, a noted scientist, Kamerlingh Omnes, and his associates have been using the facilities of the low temperature laboratory at Leyden for investigations along several lines. Of these low temperature researches, perhaps the most fascinating are those dealing with the effects on electrical resistance of metals. In the case of solid mercury, it was found that the resistance follows the ordinary well-known law of change with temperature down to about 4.2 deg. Absolute, or 268.8 deg. below zero deg. Centigrade. But here a very sudden change occurs. Between 4.21 deg. A. and 4.19 deg. A. the resistance decreases enormously and the metal becomes "superconductive." At 3.6 deg. A. the resistance is less than four ten millionths of its resistance at 0 deg. C. and at 2.45 deg. A. the resistance is less than half of this amount. An applied potential difference of .56 microvolt gave a current density of 1024 amp. per sq. mm. This enormous value is almost inconceivable. Lead and tin showed similar changes in resistance. With tin the superconductive state was reached at about 3.8 deg. A., while in the case of lead it occurred between 14 deg. A. and 4.3 deg. A. Apparently when in the superconductive state we could send thousands of horsepower over a mere thread of wire with a potential of only a fraction of a volt. One experiment with a lead coil was very remarkable. By means of a powerful magnet a current was induced in a coil of lead in the superconductive state. This current continued apparently without diminution for over 4 hr. This according to our known laws is practically an impossibility. Yet experiment demonstrated it as a fact.

Are the laws of science at fault? Indeed no, not in the least. It merely indicates that there are other laws that still remain to be discovered. In the meantime, the next step which Kamerlingh Omnes makes in the attainment of his goal, the "absolute zero," will be awaited with great interest.

Power Plant Slogans

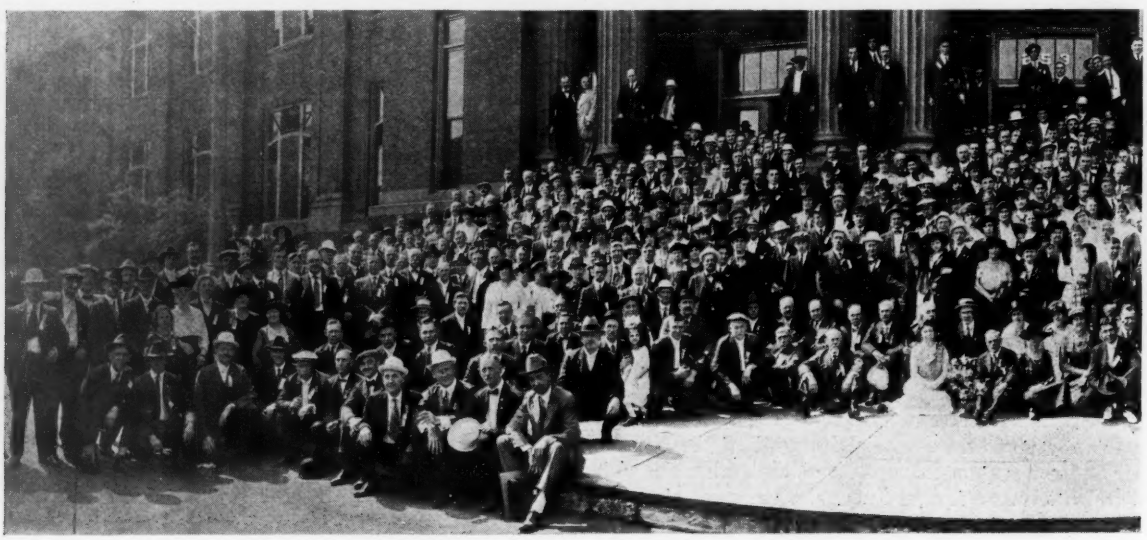
Store Coal in Summer.
Keep and Analyze Operating Records in Every Power Plant.
Develop Water Power Sites.
Promote Health and Safety in Power Plants.
Handle Coal and Ashes Mechanically.
Employ Engineers for Engineering Work.

Milwaukee Entertains N. A. S. E.

N. A. S. E. Delegates from Far and Near Meet at the Annual Convention, Sept. 13-18

FOR THE fourth time since the founding of the association over 40 yr. ago, Milwaukee opened wide its portals Monday, Sept. 13, to welcome the delegates of the National Association of Stationary Engineers to their 38th annual gathering. The day dawned bright and cheerful and the almost unbroken stream of delegates and visitors that found their way into the city from all directions, among other things anhydrous, found the weather gloriously dry. Despite the dryness that prevailed, however, it was a happy throng which took possession of the Hotel Wisconsin, the convention headquarters, and the absence of the product which once made Milwaukee famous was little noted.

Official registration of officers, delegates and visitors began promptly at 9 a. m. at the Milwaukee Auditorium.



DELEGATES AND VISITORS AT MILWAUKEE

The local reception committee was on hand all day and as the various delegations arrived escorted them to the Auditorium.

In the afternoon a party of delegates visited the Oneida Street Plant of the Milwaukee Electric Railway and Light Co., where they inspected the pulverized coal burning installation.

Activities did not commence, however, until Monday evening when the exposition of mechanical equipment was opened. The band, of course, led the way from the hotel to the Milwaukee Auditorium. This is one of the most modern and best equipped combined concert and convention buildings in the world. The main arena is capable of seating 10,000 people and the 250 booths which comprised the exhibit found ample space for the full display of their wares in this hall. Under the same roof are six smaller auditoriums, splendidly equipped, one of which, Juneau Hall, served as the convention hall.

The exhibit shattered all previous records for completeness and size. Everything in the power plant equipment line was on display from a globe valve to a complete refrigerating machine in full operation or a complete gas burning steam plant.

After a band concert, the exhibit was formally opened at 8:30 p. m. with Charles F. Bindrich, chairman of the convention committee, presiding. Horace A. Smith, president of the National Exhibitors' Association, in his address called attention to the educational value of exhibits of this type, urging everyone to derive the greatest benefit from it by making themselves known and by getting acquainted. "Let the experts in their individual lines here give you the benefit of their experience and knowledge," he said. "Under this roof are concentrated all the approved and successful devices and methods employed in the profession, and there is something here for everybody to learn."

Eltinge Elmore, representing the Association of Commerce, welcomed the convention to Milwaukee.

The refreshments in the form of cider and doughnuts, served in the lobby of the auditorium, were enjoyed by all.

Tuesday morning the delegates assembled in Juneau Hall and at 10:30 the convention was formally opened with an address of welcome on behalf of the local association by Charles F. Bindrich, chairman of the local convention committee. Mayor Hoan, of Milwaukee, welcomed the delegates and guests to the city and delivered a short talk on the city of Milwaukee. The mayor's address was responded to by National President John J. Calahan, who accepted the generous welcome thus extended and thanked the city for its hospitality.

Other speakers were Alfred Johnson, National Vice-president; Past President Roderick Mackay, of California; James G. Beckerleg, of Chicago, and Phil. A. Grau, business manager of the Association of Commerce. The latter's address was particularly interesting and as a story teller he has no equal. For the better part of a

half hour he held the audience spellbound, and the rousing round of applause which was given him when he finished, indicated their appreciation.

Just before the closing of the morning session, President Calahan appointed members to serve on the following committees: Ways and Means, Analysis and Distribution, Resolutions, Mileage, Credentials, Auditing, Referendum, and Ritual.

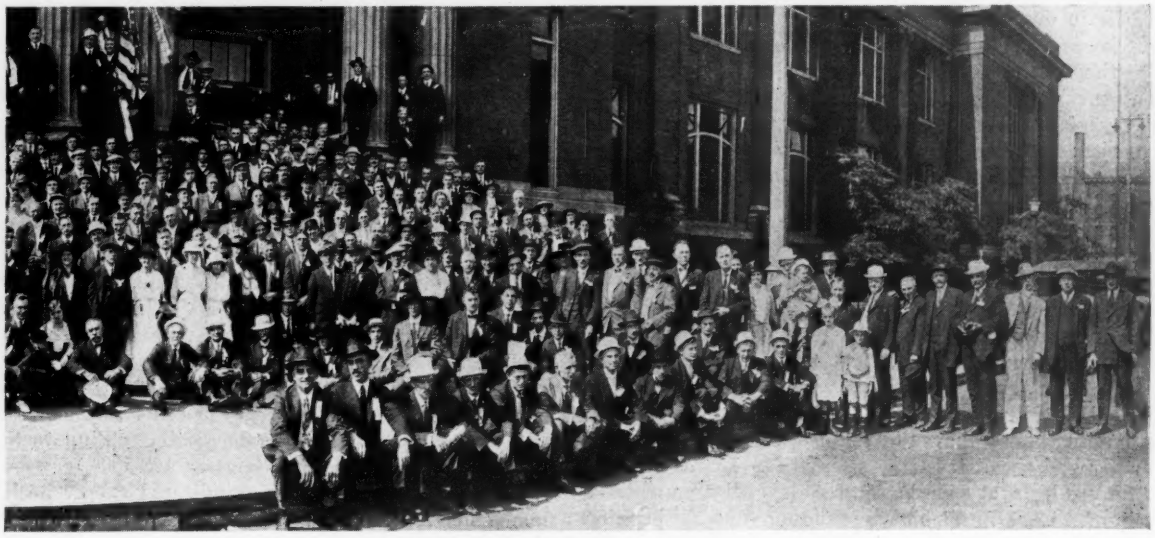
The first business session of the convention convened at 1:45 p. m. with President Calahan in the chair. The first order of business was a preliminary report of the Credentials Committee showing the attendance of 307 delegates. Then came the following reports: President, National Deputy, National Secretary, National Treasurer, License Committee, Technical Papers Committee, Power Plants Costs Committee, Membership Extension Committee and Educational Committee.

The president in his report stated that the financial condition of the association was never at so high a tide as at the present time. "The $40,000 now on hand," he said, "speaks well for the stability of the organization."

He recommended that the National Association of Stationary Engineers enter a strong protest with the United States Civil Service Commission and with Senator Francis E. Warren, of Wyoming, and Congressman Frederick R. Lehlback, of New Jersey, protesting discrimination against power plant engineers in the various government departments at Washington, D. C., because studious men are barred in the civil service. This would create a preferred class and would become a reactionary means of compensation. Congress now has before it a bill to reclassify and revise the titles and compensations of its employes. The title of engineer has been changed to read "engineman," also in several departments the engineers are transferred from the per diem roll to the per annum roll at a reduced compensation. "I believe the change unjust and a detriment to the engineer," said President Calahan. "Some years ago the Civil Service Commission issued an order that applicants for the position of chief engineer should possess a technical education to qualify them to take the examination. The N. A. S. E. entered a strong protest and the Civil Service Commission recalled their order. Under this new rule, if it becomes operative, the chief engineman could not be promoted to the position of mechanical engineer or superintendent, whereas an electrician, which means dynamo tender, switchboard tender or wireman, may become electrical engineer, mechanical engineer or superintendent."

The president recommended that the education committee be continued along the same lines as in the past. He did not recommend or approve the recommendation of this committee to appoint a national educator at a salary of $6000 per year. "I believe it unwise and unnecessary to create such a position," said the president.

In regard to the N. A. S. E.'s attitude toward other associations, President Calahan said: "We desire to win our way to success by honest effort and by the honorable character of our members. We are endeavoring to secure recognition by means of conservative and intelligent efforts, thus gaining the confidence, not only of employers and employes, but also of the public in general. The fundamental theory of American government is founded upon equal right and equal opportunities for all, upon personal liberty, upon freedom of action of individuals. It was a protest against personal and political domination of individual thought and action. This spirit has shaped and colored all our laws. Our association stands higher in the respect of the people of the country today than at any time in the history of the organization and we wish to retain this proud position. To accomplish this it is only necessary to continue the faithful adherence to our principles of non-interference with other organizations."



DELEGATES AND VISITORS AT MILWAUKEE

At the close of this session at 3:15 the majority of the delegates availed themselves of the opportunity of visiting the plant of the Nordberg Manufacturing Co. Four special trolley cars took the party to the plant where they inspected with interest the construction of large Diesel engines, steam engines and heavy duty hoisting machinery.

As the annual meeting of the Life and Accident Department had unfortunately been scheduled for the same time as the trip to the Nordberg plant, those interested in that department remained behind.

James G. Beckerleg, of Chicago, a charter member of the association and a trustee of the life and accident fund for 32 yr., declined re-election and the ballot resulted in the choice of J. F. Leeson, of Chicago, who will serve for 5 yr.

Judson Pratt, of Cincinnati, was re-elected chairman of the board of trustees and James D. Taylor re-elected secretary and treasurer by acclamation.

The stag and smoker which was held at the Auditorium Tuesday night, was a huge success and enjoyed by all. Wallace Chambers, of the U. S. Rubber Co., singer, composer and a man from Dixie, furnished an excellent act.

Wednesday morning, after the business session which convened at 9:30, the delegates assembled to hear a lecture by H. P. Wilder, of Detroit, Mich., on "The Progressive Engineer." "It is the progressive engineer who is in demand today," said Mr. Wilder, "the man who keeps up with all the latest developments in his line. The time has passed when a man could rely solely upon the experience gained from his immediate surroundings in the plant. He must supplement the knowledge his experience conveys to him with the knowledge derived from technical books and engineering journals. 'He knows' are the two words which characterize the progressive engineer of today.

Next in order on the morning's program was an illustrated lecture on "Science and Engineering," by Ben G. Elliot, professor of mechanical engineering at the University of Wisconsin. He said that the great difficulty among engineers is that they do not grasp some of the fundamental laws underlying their profession. Using Professor Elliot's own words, "Engineering is nothing more than the application of the laws of physics and chemistry to everyday life. If the engineer but keeps his eyes open he can see the operation of these laws of science in all his surroundings—in the burning of the fuel in the furnace, in the action of the steam behind the piston, in fact, everywhere he looks. The combustion of fuel is governed by definite scientific laws—laws of chemistry. The regulation of the chemical action called combustion consists merely in supplying the proper amount of oxygen to the fuel bed." This portion of the lecture was followed by simple illustrations regarding the amount of heat evolved in burning coal to CO and to CO_2, and by some fundamental definitions of the terms, force, work and energy. "The engineer," concluded the lecturer, "should learn and know the stepping stones which are the foundation of his profession. There are big jobs these days, but the man who wants them must be big enough to fill them."

The morning's program closed with an address by Mr. Albertus Perry, field representative of central division of the American Red Cross. This very interesting lecture which outlined the work and needs of the Red Cross was well worth hearing and was bound to augment one's admiration for that wonderful organization with its 25,000,000 members.

Except for the morning's business and technical session Wednesday was indeed a gala day for the delegates, exhibitors, ladies and guests. In cars especially provided, the visitors hied themselves to Washington Park, one of Milwaukee's most beautiful recreation spots and playgrounds located near the western city limits. Many and varied were the games played and contests staged and to round out a most delightful afternoon it was the privilege of the boys to witness a most exciting series of horse races given under the auspices of the local Association of Commerce.

Shortly after 6 o'clock, the doors of the exhibit hall were again thrown open to the public and while some of the delegates were entertained in one of the halls to a very excellent program of motion pictures portraying the industries and industrial life of the city, others together with thousands of interested guests thronged the big Auditorium to view one of the most interesting, instructive and stupendous expositions of mechanical and electrical appliances and devices ever shown at any convention of the National Association of Stationary Engineers.

Thursday's Program

According to custom, Thursday morning was also given over to the transaction of business and the presentation and discussion of an exceedingly interesting and valuable paper by Charles A. Cahill, consulting engineer of Milwaukee, entitled "Capacity and Maintenance Costs."

The business section convened promptly at 9:10 with President Calahan in the chair. Committee reports were read. No changes were offered or suggested by the Ritual Committee, the Credential Committee reported an attendance of 324 delegates while the Mileage Committee reported the delegates' total mileage to be about 235,000.

Due to the present day high cost of transportation and hotels, it was voted to pay 5 cents a mile with a bonus of an additional 5 cents a mile, calling forth a total expenditure of approximately $23,500.

The report of the Trustees indicated a very healthy financial condition of the Association. The total receipts for the fiscal year far exceeded all former records, aggregating about $30,000.

Action was then taken by the delegates whereby in the future a better understanding and greater degree of co-operation is bound to exist than heretofore between the National Association of Stationary Engineers and the National Exhibitors' Association.

Various amendments to both National and subordinate association constitutions were proposed in the report of the Referendum Committee. Most important among the proposals were those aiming to change the name of the National Association of Stationary Engineers to that of National Association of Engineers; the creation of a Convention City Committee; the payment of mileage only to delegates in actual attendance at the convention; and a change of the wording of the preamble to the constitution, the exact reading of which is to appear in the official referendum ballot.

After the completion of the session, the officers of the National Ladies' Auxiliary were received by the convention. Brief addresses were made by President Calahan of the N. A. S. E., Anna C. Aitkamper, president of the Auxiliary, and by Sadie Armer and Gertrude P.

Hunt, both past president of the ladies' organization. It was voted to donate $100 to the Auxiliary.

Following was the annual memorial service. After reading of the names of those members who during the past year had been called home and a eulogy of the dead by President Calahan, Robert Jones of New York rendered "Nearer, My God, to Thee," the audience meanwhile standing in meditation.

The afternoon business session, which convened at 2:05 with Vice-President Johnson in the chair, was given over principally to the reading of committee reports. At 3:15 the session adjourned to allow the delegates and their guests and friends to visit the West Allis shops of the Allis-Chalmers Manufacturing Co.

Except for a number of visitors comparatively few remained in the exhibit hall during the evening, as at 8 o'clock the annual entertainment by the National Exhibitors' Association was staged in Plankinton Hall of the Auditorium.

And Friday—

The last day of the convention was one devoted to some of the most important questions to come before the delegates, that is, to the election of officers for the ensuing year and the selection of the 1921 convention city. Shortly after 9 o'clock, the meeting was called to order with President Calahan in the chair. Reports of the Auditing, Ways and Means and Resolutions Committees were read and approved by the convention. Particular interest centered on the report and recommendation of the Resolutions Committee, which included the suggestion that action be taken to bring about greater co-operation between the Educational Committee and the various state universities and colleges of engineering, the aim of the framers of the resolution being to secure for the subordinate associations and the individual members the advantages offered by the equipment and faculties of such institutions. The resolution was voted adopted.

Action was also taken whereby a bonus of $1000 is to be paid to National Secretary Raven.

Last, but by no means the least of important business transacted by the convention, was the election of officers. Upon recommendation of the Nominating Committee, Alfred Johnson, of Chicago, was elected president.

Two candidates were up for vice-president, Frederick Felderman and Richard W. Perry, who, with 182 votes out of a total of 311 cast, secured that much coveted office.

Fred Raven and Sam Forse were re-elected National Secretary and Treasurer, respectively.

The election of National Trustee resolved itself into a three-cornered fight, with Harry R. Hilton, of California; John Mullen, of Massachusetts, and Peter O. Johnson, of Pennsylvania, the contestants. Official count revealed Harry Hilton leading with 167 votes, followed by Johnson with 85 and Mullen with 60.

The final ballot cast was for the selection of the 1921 convention city. At a conference of committees appointed by the National Association of Stationary Engineers and the National Exhibitors' Association, Rochester, N. Y., and Springfield, Mass., were selected, and presented to the delegates for their consideration. At the balloting which followed, 80 votes were cast for Springfield and 220 for Rochester.

With the Exhibitors

Neither delegates or visitors hesitated to compliment the members of the National Exhibitors' Association who were responsible for the exposition of power plant equipment and appliances held in conjunction with the convention. Booths were placed not only on the main floor of the hall, but also on the stage at the north end. The color scheme employed was white with pale blue, which, together with profuse floral decorations and the extensive display of the National colors, gave to the whole a most pleasing and inviting appearance.

List of Exhibitors

Among those having exhibits of power plant machinery or equipment were the following:

Allis-Chalmers Co., Milwaukee, Wis.; American Huhn Metallic Packing Co., New York, N. Y.; American Machinery Co., Milwaukee, Wis.; American Steam Gauge and Valve Co., Boston, Mass.; American Steam Conveyor Corp., New York, Chicago; Andrae & Sons Co., Julius, Milwaukee, Wis.; Andrews, Bradshaw Co., Pittsburgh, Pa.; Anchor Packing Co., Chicago, Ill.; Anderson Co., V. D., Cleveland, Ohio; Arrow Boiler Compound Co., St. Louis, Mo.; Ashton Valve Co., Cambridge, Mass.; Automatic Fuel Saving Co., Chicago, Ill.; Automatic Furnace Co., Dayton, Ohio; Bair, Edward H., Milwaukee, Wis.; Bartles-Maguire Oil Co., Milwaukee, Wis.; Barret-Christie Co., Chicago, Ill.; Bayley Mfg. Co., Chicago, Ill.; Birch Pump Valve Co.; Birkholz & Cross, Milwaukee, Wis.; Boiler Kote Co., Chicago, Ill.; Boylston Steam Specialty Co., Chicago, Ill.; Brady Foundry Co., James A., Chicago, Ill.; Brooks Oil Co., Cleveland, Ohio; Burdick Electric Co., Milwaukee, Wis.; Bussman Mfg. Co., St. Louis, Mo.; Calebaugh Self-Lubricating Carbon Co., Philadelphia, Pa.; Carling Turbine Blower Co., Worcester, Mass.; Chicago Engineers' Supplies Co.; Chicago Fuse Mfg. Co., Chicago, Ill.; Classmann, Wm., Milwaukee, Wis.; Combustion Engineering Corp., New York City; Combustion Publishing Co., New York City; Chapman Valve Mfg. Co., Indian Orchard, Mass.; Crandall Packing Co., Chicago, Ill.; Cream City Chemical Works, Milwaukee, Wis.; Crane Co., Chicago, Ill.; Crane Packing Co., Chicago, Ill.; Davison Gas Burner Welding Co., Pittsburgh, Pa.; Dearborn Chemical Co., Chicago, Ill.; Dengel Mfg. Co., Milwaukee, Wis.; Dixon Crucible Co., Jersey City, N. J.; Dorner, F. H., Milwaukee, Wis.; Downing, I. W., Milwaukee, Wis.; Dunham Co., C. A., Milwaukee, Wis.; Economy Laboratories Co.; Edge Moor Iron Works, Edge Moor, Del.; Edward Valve & Mfg. Co., Chicago, Ill.; Electrical Engineers' Equipment Co., Milwaukee, Wis.; Elevator Supplies Co., Inc., Chicago, Ill.; Elliott Co., Pittsburgh, Pa.; Ellison, Lewis M., Chicago, Ill.; Famous Sales Co., Chicago, Ill.; Farnsworth Co., Conshohocken, Pa.; Federal Asbestos Rubber Co., Milwaukee, Wis.; Fisher Governor Co., Marshalltown, Iowa; Flexible Steel Lacing Co., Chicago, Ill.; Ford Co., J. B., Wyandotte, Mich.; France Packing Co., Philadelphia, Pa.; Freeman Mfg. Co.; Garlock Packing Co., Palmyra, N. Y.; Garratt Callahan Co., Chicago, Ill.; Goodsell Packing Co., Maywood, Ill.; Greene, Tweed & Co., New York, N. Y.; Greers Fire Brick Co., A. P.; Gross Hardware & Supply Co., Milwaukee, Wis.; Hawk-Eye Compound Co., Chicago, Ill.; Hays Corp., Jas. W., Milwaukee, Wis.; Hays School of Combustion, Chicago, Ill.; Heller Elevator Co., S.; Hennebohle, F., Chicago, Ill.; Hoffmann Mfg. Co., B., Milwaukee, Wis.; Hoffmann & Billings Mfg. Co., Milwaukee, Wis.; Hollow Center Packing Co.; Home Rubber Co., Trenton, N. J.; Illinois Engineering Co., Chicago, Ill.; Independent Oil & Grease Co., Milwaukee, Wis.; Industrial Heating & Engineering Co., Milwaukee, Wis.; Jeffrey Mfg. Co., Columbus, Ohio; Jenkins Bros., New York, N. Y.; Jenkins Machine Co., Sheboygan, Wis.; Johns-Manville Co., The; Johns-Pratt Co., Hartford, Conn.; Jointless Firebrick Co., Chicago, Ill.; Jutter Co., Wm. H., Milwaukee, Wis.; Keckley Co., O. C., Chicago, Ill.; Kent Lubricating Co., Milwaukee, Wis.; Keystone Lubricating Co., Philadelphia, Pa.; Kidwell Boiler & Engineering Co.; Kunz, Wm. J., Milwaukee, Wis.; Lagonda Mfg. Co., Springfield, Ohio; Leschen & Sons Rope Co., St. Louis, Mo.; Liberty Mfg. Co., Pittsburgh, Pa.; Lindsay McMillan Co.; Liptak Firebrick Arch Co., Minneapolis, Minn.; Locomotive Superheater Co., New York, N. Y.; Lunkenheimer Co., Cincinnati, Ohio; Lynch-Clarisey Co., Chicago, Ill.; Magnesia Association of America, Philadelphia, Pa.; Manning, Maxwell & Moore, Inc., New York, N. Y.; Marion Foundry Corp., Marion, Ind.; Mason Regulator; McCoy, Nolan; McCullough Mfg. Co., Minneapolis, Minn.; McLeod & Henry Co., Troy, N. Y.; Mechanical Appliance Co., Milwaukee, Wis.; Milwaukee Tank Works, Milwaukee, Wis.; Milwaukee Plumbing & Heating Supply Co., Milwaukee, Wis.; Milwaukee Reliance Boiler Works, Milwaukee, Wis.; Millner, M. D.,

Milwaukee, Wis.; Mueller Boiler Compound Co., Minneapolis, Minn.; National Educational Committee, N. A. S. E., Madison, Wis.; National Engineer, Chicago, Ill.; National Tube Co., Pittsburgh, Pa.; New York Belting & Packing Co., New York, N. Y.; Nordberg Mfg. Co., Milwaukee, Wis.; Nugent & Co., W. W., Chicago, Ill.; Otis Elevator Co., Chicago, Ill.; Perolin Co. of America, Chicago, Ill.; Petley Co., J. R., Milwaukee, Wis.; Philadelphia Grease Mfg. Co., Philadelphia, Pa.; Pioneer Rubber Mills, San Francisco, Cal.; Poole Engineering & Machine Co., Baltimore, Md.; Powell Co., Wm., Cincinnati, Ohio; Power, New York, N. Y.; Power Plant Engineering, Chicago, Ill.; Pyro Boiler Products Co., Milwaukee, Wis.; Quaker City Rubber Co., Philadelphia, Pa.; Quigley Furnace Specialties Co., New York, N. Y.; Randall Control & Hydrometric Corp., Los Angeles, Cal.; Rasmussen Co., Julius, Milwaukee, Wis.; Reiter Boiler Cleaner Co., Elgin, Ill.; Republic Flow Meters Co., Chicago, Ill.; Richardson-Phenix Co., Milwaukee, Wis.; Richardson Scale Co., Chicago, Ill.; Roeblings Sons Co., John A., Chicago, Ill.; Roto Co., Hartford, Conn.; S-C Regulator Co., Fostoria, Ohio; Schertl, K. G., Milwaukee, Wis.; Scully Steel & Iron Co., Chicago, Ill.; Shear-Klean Grate Co., Chicago, Ill.; Soulen, Peter J., Milwaukee, Wis.; Southern Engineer, Atlanta, Ga.; Smiley, H. A., Milwaukee, Wis.; Squires Co., C. E., Cleveland, Ohio; Standard Sanitary Mfg. Co., Milwaukee, Wis.; Sterling Engineering Co., Milwaukee, Wis.; Sterling Products Co., Cleveland, Ohio; Strong, Carlisle & Hammond Co., Cleveland, Ohio; Sugar Beet Products Co., Saginaw, Mich.; Texas Co., New York, N. Y.; Toledo Pipe Threading Machine Co., Toledo, Ohio; Trico Fuse Co., Milwaukee, Wis.; Uehling Instrument Co., New York, N. Y.; Underfeed Stoker Co. of America, Detroit, Mich.; United States Rubber Co., New York, N. Y.; Vacuum Oil Co., Chicago, Ill.; Vilter Mfg. Co., Milwaukee, Wis.; Viscosity Oil Co., Milwaukee, Wis.; Voorhees Rubber Mfg. Co., Jersey City, N. J.; Western Iron Stores Co., Milwaukee, Wis.; Westinghouse Traction Brake Co., Pittsburgh, Pa.; Wickes Boiler Co., Saginaw, Mich.; Wisconsin Electrical Mfg. Co., Milwaukee, Wis.; Wisconsin Stable Equipment Co., Milwaukee, Wis.

N. E. A. Officers Elected

At the business meeting of the National Exhibitors' Association held Thursday, Sept. 16, at 4:30, the following officers were elected: President, F. N. Chapman, of the Leschen Rope Co.; vice-president, Frank Martin, of Jenkins Bros.; treasurer, A. W. France, of France Packing Co.; and an executive committee composed of Hudson Dickerman, W. L. Schaefer, E. E. Jones, L. E. Hilton and G. E. Rowland.

News Notes

The annual meeting of the Oil Engine Manufacturers' Society, which includes in its membership practically all builders of semi-Diesel fuel oil engines throughout the country, was held on Aug. 10 at Grove City, Pa., the Bessemer Gas Engine Co. courteously granting the use of its spacious club room for the purpose. The Society aims to promote the general welfare of the industry and through co-operative efforts to educate possible users in the benefits to be derived from the installation of oil engines, as well as to eliminate where possible undesirable business practices and unethical competition, and in general to establish the industry on the highest possible plane of efficiency and service. Officers for the ensuing year, likewise a new membership committee, were elected as follows: President, H. L. Dean, Chicago Pneumatic Tool Co., New York, N. Y.; vice president, W. N. Durbin, Anderson Foundry and Machine Co., Anderson, Ind.; treasurer, F. B. Morrison, Power Manufacturing Co., Marion, Ohio; secretary, C. B. Humphrey, Worthington Pump and Machinery Co., New York, N. Y.; membership committee, C. F. Fithian, Bessemer Gas Engine Co., Grove City, Pa; G. A. Herrett, Buckeye Machine Co., Lima, Ohio; O. G. Deane, Muncie Oil Engine Co., Muncie, Ind.

The directors of The C. & G. Cooper Co. of Mt. Vernon, Ohio, at the regular June meeting elected B. B. Williams president of the company to succeed D. B. Kirk, deceased. F. H. Thomas was elected vice president to succeed Mr. Williams and N. L. Daney was elected treasurer to succeed Mr. Thomas. This makes the executive organization of the board as follows: Mr. Williams, president and general manager; Mr. Thomas, vice president in charge of sales; Mr. Taylor, secretary in charge of production; Mr. Daney, treasurer in charge of finance and accounting.

These members of the board with five other officers of the company constitute the Committee of Management which makes effective the operating policies of the company. The other members of this committee are B. L. Larsen, general superintendent; P. D. Worley, purchasing agent and traffic manager; M. A. Thiel, consulting engineer, Gas Engine Department; J. H. Debes, consulting engineer, Steam Engine Department, and H. A. Gehres, who is in charge of steam and gas engineering. Mr. Cooper and G. S. Rentschler of Hamilton, Ohio, are members of the Board of Directors.

The Chapman Engineering Co., The Chapman-Stein Furnace Co. and The Marion Die, Tool & Machine Co., at Marion, Ohio, are subsidiaries of The Cooper Co.

Celite Products Co. announces that it is now represented in the Buffalo district by The Empire Co., 344 Ellicott Sq., Buffalo, N. Y., with N. G. Clarke as general manager.

The Jeffrey Manufacturing Co. has opened a new branch office in Buffalo, at 1108 Marine Trust Bldg., in order to render more efficient service and to obtain close co-operation with customers in western New York. H. W. Scott, formerly of the home office, will have charge of the new office.

S. W. Fries has been appointed district sales manager for Kansas City territory of Economy Fuse and Manufacturing Co., with offices at 1205 Commerce Bldg., Kansas City, Mo. Mr. Fries succeeds R. P. Crawley, who has resigned the position to take over the active management of the Crawley Electric Co. of Peoria, Ill.

Trade News

The National Carbon Co. of Cleveland, Ohio, has released to the trade its new motor and generator brush catalog No. 35. The catalog is designed to assist the operator as well as the engineer toward a better understanding of brushes, and in preparing it the problems of manufacturers, designers and operators have been borne in mind.

Miniature Catalog No. 5-A-1, giving a complete list of all insulating material and supplies, has just been issued by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. Included in the list of products described are: mica, Micarta and Bakelite Micarta plates and tubing, treated and untreated cloths and papers, insulating and soldering compounds, insulating oils and tapes.